

The Graduate School of Arts and Sciences

2011–2012



Bulletin of Wake Forest University

Cover: Wake Forest computer science professor Jennifer Burg works with graduate student Dan Xue (right) in the digital media lab in Manchester Hall on the Reynolda Campus.

Wake Forest University is committed to administer all educational and employment activities without discrimination because of race, color, religion, national origin, age, sex, veteran status, handicapped status, disability, or genetic information as required by law. In addition, Wake Forest rejects hatred and bigotry in any form and adheres to the principle that no person affiliated with Wake Forest should be judged or harassed on the basis of perceived or actual sexual orientation, gender identity, or gender expression.

In affirming its commitment to this principle, Wake Forest does not presume to control the policies of persons or entities not affiliated with Wake Forest, and does not extend benefits beyond those provided under other policies of Wake Forest.

The University has adopted a procedure for the purpose of resolving discrimination complaints. Inquiries or concerns should be directed to: Reynolda Campus, 336.758.4814; Bowman Gray Campus, 336.716.6123. Individuals with disabilities or special print-related needs may contact the Learning Assistance Center at 336.758.5929 or lacenter@wfu.edu for more information.

New Series
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GRADUATE SCHOOL
2011/2012

Arts and Sciences
Biomedical Sciences

Wake Forest University

Bowman Gray Campus

2011-2012 Academic Calendar

Fall Semester 2011

August 9-12	Tuesday-Friday	Mandatory new student orientation/registration
August 31	Wednesday	Classes begin
September 5	Monday	Labor Day holiday
September 14	Wednesday	Last day to add courses
September 16	Friday	Deadline to file statement of intent to graduate Dec. 30
October 5	Wednesday	Last day to drop courses
November 11	Friday	Deadline to submit thesis or dissertation to graduate Dec. 30 (to the Graduate School office for review)
November 14-Dec. 5		Registration for spring 2012
November 23-25	Wednesday-Friday	Thanksgiving holiday
December 9	Friday	Classes end
December 12-16	Monday-Friday	Examinations
December 14	Wednesday	Last day to defend to graduate Dec. 30
December 16	Friday	Deadline to submit final thesis or dissertation / Dec. grads
December 23	Friday	Grades due
December 30	Friday	Graduation

Spring Semester 2012

January 18	Wednesday	Classes begin
February 1	Wednesday	Last day to add courses
February 3	Friday	Deadline to file statement of intent to graduate May 21
February 22	Wednesday	Last day to drop courses
March 12-16	Monday-Friday	Spring recess
April 6	Friday	Good Friday holiday
April 13	Friday	Deadline to submit final thesis or dissertation/May grads
April 15-May 2		Registration for summer session 2012
May 2	Wednesday	Classes end
May 3	Thursday	Last day to defend to graduate May 21
May 7-11	Monday-Friday	Examinations
May 11	Friday	Deadline to submit final thesis or dissertation/May grads
May 18	Friday	Grades due
May 19	Saturday	Hooding and Awards Ceremony
May 21	Monday	Commencement

Summer Session 2012

May 16	Wednesday	Summer session begins
May 23	Wednesday	Last day to add/drop courses
June 1	Friday	Deadline to file statement of intent to graduate Aug. 15
July 2-13		Registration for returning students/fall 2012
July 2	Monday	Last day to submit thesis to graduate Aug. 15
July 30	Monday	Last day to defend to graduate Aug. 15
August 1	Wednesday	Deadline to submit final dissertation for Aug. graduates
August 3	Friday	Summer session ends
August 10	Friday	Grades due for summer session
August 15	Wednesday	Graduation

Reynolda Campus

2011-2012 Academic Calendar

Fall Semester 2011

August 29-30	Monday-Tuesday	Registration for new students
August 29	Monday	New-student orientation
August 31	Wednesday	Classes begin
September 14	Wednesday	Last day to add courses
September 16	Friday	Deadline to file statement of intent to graduate Dec. 30
October 5	Wednesday	Last day to drop courses
October 21	Friday	Fall break
November 7-18		Registration for spring 2012
November 11	Friday	Deadline to submit thesis or dissertation to graduate Dec. 30 (to the Graduate School office for review)
November 23-27	Wednesday-Sunday	Thanksgiving holiday
December 9	Friday	Classes end
December 12-17	Monday-Saturday	Examinations
December 16	Friday	Deadline to submit final thesis or dissertation / Dec. grads
December 30	Friday	Graduation

Spring Semester 2012

January 16	Monday	Martin Luther King Jr. holiday
January 17	Tuesday	Registration for new students
January 18	Wednesday	Classes begin
February 1	Wednesday	Last day to add courses
February 3	Friday	Deadline to file statement of intent to graduate May 21
February 22	Wednesday	Last day to drop courses
March 10-18	Saturday-Sunday	Spring break
March 12-April 20		Registration for summer 2012
April 2-13		Registration for fall 2012
April 6	Friday	Good Friday holiday
April 13	Friday	Deadline to submit thesis or dissertation to graduate May 21 (to the Graduate School office for review)
May 2	Wednesday	Classes end
May 4-5	Friday-Saturday	Examinations
May 7-10	Monday-Thursday	Examinations
May 11	Friday	Deadline to submit final thesis or dissertation / May grads
May 19	Saturday	Hooding and Awards Ceremony
May 21	Monday	Commencement

Summer Session 2011

May 24-June 29		Summer Session I
July 6-August 10		Summer Session II
August 15	Monday	Graduation

Programs of Study

The Graduate School conducts programs on the Bowman Gray campus (location of the Wake Forest University School of Medicine) and the Reynolda campus (undergraduate and associated graduate programs). On the Bowman Gray and associated campuses of the medical school, the Graduate School offers PhD programs in biomedical sciences and masters programs in biomedical engineering, comparative medicine, clinical and population translational sciences, and molecular medicine and

translational science. The PhD programs in biology, chemistry, and physics, and masters-only programs in twelve disciplines, ranging from bioethics to religion, are located on the Reynolda campus. The Graduate School also offers nine joint degree programs in conjunction with the Wake Forest University School of Medicine, the Schools of Business, the School of Divinity, and the School of Law; as well as five certificate programs.

Master Programs

Program	Degree(s)	Director(s)	Email
Bioethics	MA	Mr. Brad J. Tharpe	btharpe@wakehealth.edu
Biology	MS	Dr. Brian Tague	taguebw@wfu.edu
Biomedical Engineering	MS	Dr. Katherine Saul	ksaul@wakehealth.edu
Chemistry	MS	Dr. Paul Jones	jonespb@wfu.edu
Clinical and Population Translational Sciences (CPTS)	MS	Dr. Bob Byington	bbyingto@wakehealth.edu
Communication	MA	Dr. Ann Geiger	ageiger@wakehealth.edu
Comparative Medicine	MS	Dr. Allan Loudon	louden@wfu.edu
Computer Science	MS	Dr. Mark Cline	jmcline@wakehealth.edu
Counseling	MA	Dr. David John	djj@wfu.edu
Documentary Film	MA/MFA	Dr. Samuel Gladding	stg@wfu.edu
		Dr. Sandy Dickson	dicksosj@wfu.edu
		Dr. Mary Dalton	dalton@wfu.edu
Education	MAEd	Dr. Leah McCoy	mccoy@wfu.edu
English	MA	Dr. Eric Wilson	wilsoneg@wfu.edu
Health and Exercise Science	MS	Dr. Anthony Marsh	marshap@wfu.edu
Interpreting and Translation Studies	MA	Dr. Olgierda Furmanek	furmano@wfu.edu
Liberal Studies	MALS	Dr. David Coates	coatesd@wfu.edu
Mathematics	MA	Dr. Ellen Kirkman	kirkman@wfu.edu
Molecular Medicine and Translational Science	MS	Dr. Richard Loeser	loeser@wakehealth.edu
		Dr. Bridget Brosnihan	bbrosnih@wakehealth.edu
Physics	MS	Dr. Martin Guthold	gutholdm@wfu.edu
Psychology	MA	Dr. Eric Stone	estone@wfu.edu
Religion	MA	Dr. Jarrod L. Whitaker	whitakjl@wfu.edu

PhD Tracks of Study

Program	Degree(s)	Director(s)	Email
Track 1 Physics	PhD	Dr. Martin Guthold	gutholdm@wfu.edu
Track 2 Chemistry	PhD	Dr. Paul Jones	jonespb@wfu.edu
Track 3 Biology	PhD	Dr. Brian Tague	taguebw@wfu.edu
Track 4 Molecular and Cellular Biosciences	PhD	Dr. Roy Hantgan	rhantgan@wakehealth.edu
<i>(comprising the following programs: Biochemistry and Molecular Biology, Cancer Biology, Microbiology and Immunology, Molecular Genetics and Genomics, Molecular Medicine and Translational Science, Molecular Pathology)</i>			
Track 5 Integrative Physiology and Pharmacology	PhD	Dr. Allyn Howlett	ahowlett@wakehealth.edu
Track 6 Neuroscience	PhD	Dr. Ron Oppenheim	roppenheim@wakehealth.edu
Track 7 Biomedical Engineering	PhD	Dr. Katherine Saul	ksaul@wakehealth.edu

Joint Degree Programs

Program	Director(s)	Email
JD/MA (Bioethics)	Mr. Brad J. Tharpe	brtharpe@wakehealth.edu
JD/MA (Religion)	Dr. Jarrod L. Whitaker	whitakjl@wfu.edu
MD/MA (Bioethics)	Mr. Brad J. Tharpe	brharpe@wakehealth.edu
MD/MS (CPTS)	Dr. Bob Byington	bbyington@wakehealth.edu
	Dr. Ann Geiger	ageiger@wakehealth.edu
MD/PhD	Dr. Paul Laurienti	plaurien@wakehealth.edu
MDiv/MA (Bioethics)	Mr. Brad J. Tharpe	brtharpe@wakehealth.edu
MDiv/MA (Counseling)	Dr. Samuel Gladding	stg@wfu.edu
PhD/MBA	Dr. Dwayne Godwin	dgodwin@wakehealth.edu

Certificate Programs

Program	Director(s)	Email
Bioethics Certificate	Mr. Brad J. Tharpe	btharpe@wakehealth.edu
Interpreting and Translation Studies	Dr. Olgierda Furmanek	furmano@wfu.edu
	Dr. Sally Barbour	barbour@wfu.edu
Medieval Studies Certificate	Dr. Gale Sigal	sigal@wfu.edu
	Dr. Gillian Overing	overing@wfu.edu
Science Management	Dr. Dwayne Godwin	dgodwin@wakehealth.edu
Structural and Computational Biophysics	Dr. Fred Salisbury	salsbufr@wfu.edu

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The University

WAKE FOREST UNIVERSITY IS CHARACTERIZED BY ITS DEVOTION TO LIBERAL LEARNING AND PROFESSIONAL PREPARATION FOR MEN AND WOMEN, ITS STRONG SENSE OF COMMUNITY AND FELLOWSHIP, AND ITS ENCOURAGEMENT OF FREE INQUIRY AND EXPRESSION.

Wake Forest Institute was founded in 1834 by the Baptist State Convention of North Carolina. The school opened its doors on February 3 with Samuel Wait as principal. Classes were first held in a farmhouse on the Calvin Jones plantation in Wake County, North Carolina, near which the village of Wake Forest later developed.

Rechartered in 1838 as Wake Forest College, Wake Forest is one of the oldest institutions of higher learning in the state. The School of Law was established in 1894, followed by a two-year medical school in 1902. Wake Forest was exclusively a college for men until World War II, when women were admitted for the first time.

In 1941 the medical school moved to Winston-Salem to become affiliated with North Carolina Baptist Hospital and was renamed the Bowman Gray School of Medicine. In 1946 the trustees of Wake Forest and the Baptist State Convention of North Carolina accepted a proposal by the Z. Smith Reynolds Foundation to relocate the College to Winston-Salem. The late Charles and Mary Reynolds Babcock donated much of the R.J. Reynolds family estate as the site for the campus and building funds were received from many sources. From 1952 to 1956, the first fourteen buildings were constructed in Georgian style on the new campus. The move to Winston-Salem took place in the summer of 1956; the original, or “old” campus, is now home to Southeastern Baptist Theological Seminary.

Following the move, Wake Forest grew considerably in enrollment, programs, and stature and became a University in 1967. The School of

Business Administration, first established in 1948, was named the Charles H. Babcock School of Business Administration in 1969 and admitted its first graduate students in 1971. In 1972 the school enrolled only graduate students and the name was changed to the Charles H. Babcock Graduate School of Management; departments of business and accountancy and economics were established in the College. In 1980 the Department of Business and Accountancy was reconstituted as the School of Business and Accountancy; the name was changed to the Wayne Calloway School of Business and Accountancy in 1995. On July 1, 2009, the Wayne Calloway School of Business and Accountancy and the Charles H. Babcock Graduate School of Management officially merged under the name Wake Forest University Schools of Business.

The Division of Graduate Studies, established in 1961, is now organized as the Graduate School and encompasses advanced work in the arts and sciences on both the Reynolda and Bowman Gray campuses. In 1997 the medical school was renamed the Wake Forest University School of Medicine; its campus is now known as the Bowman Gray Campus. The School of Divinity was established in 1999.

Wake Forest honors its Baptist heritage in word and deed. The University will fulfill the opportunities for service arising out of that heritage. Governance is by an independent Board of Trustees; there are advisory boards of visitors for the College and each professional school. A joint board of University trustees and trustees of the North Carolina Baptist Hospital is responsible for Wake Forest University Baptist Medical Center, which includes the hospital and the medical school.

The College, Schools of Business, School of Law, the Graduate School, and the School of Divinity are located on the Reynolda Campus in northwest Winston-Salem and the Morrocroft Campus in Charlotte, NC. The Wake Forest School of Medicine is about four miles away, near the city's

downtown. The University also offers instruction regularly at Casa Artom in Venice, at Worrell House in London, at Flow House in Vienna, and in other places around the world.

The College offers courses in more than forty fields of study leading to the baccalaureate degree. The School of Divinity offers the master of divinity degree.

The Wake Forest Schools of Business offer a four-year bachelor of science degree, with majors in accountancy, business and enterprise management, finance, and mathematical business (offered jointly with the Department of Mathematics); and three graduate degree programs, master of science in accountancy (MSA), master of arts in management (MA), and master of business administration (MBA).

The School of Law offers the juris doctor and master of laws in American law degrees. The school also offers a joint JD/MBA degree with the Schools of Business.

In addition to the doctor of medicine degree, the Wake Forest School of Medicine offers, through the Graduate School, programs leading to the master of science and doctor of philosophy degrees in biomedical sciences. The School of Medicine and the Schools of Business offer a joint MD/MBA program.

The Graduate School confers the master of arts, master of arts in education, master of arts in liberal studies, master of fine arts, and master of science degrees in the arts and sciences and the doctor of philosophy degree in biology, chemistry, and physics. The Graduate School also offers an MD/PhD program jointly with the School of Medicine and a PhD/MBA program jointly with the Schools of Business. In addition, the Graduate School offers a MDiv/MA in counseling or bioethics jointly with the School of Divinity; and a JD/MA in bioethics or religion jointly with the School of Law.

Libraries

The libraries of Wake Forest University support instruction and research at the undergraduate level and in the disciplines awarding graduate degrees. The libraries of the University hold membership in the American Library Association and in the Association of Southeastern Research Libraries. They

rank among the top libraries in the Southeast in expenditures per student.

The Wake Forest University libraries include the Z. Smith Reynolds Library, which is located on the Reynolda Campus and supports the undergraduate College, the Wake Forest Schools of Business undergraduate program, the Graduate School of Arts and Sciences, and the School of Divinity. The Professional Center Library, housed in the Worrell Professional Center on the Reynolda Campus, serves the School of Law and the Wake Forest Schools of Business graduate program. The Coy C. Carpenter Library serves the Graduate School of Arts and Sciences and the Wake Forest School of Medicine and is located on the Bowman Gray Campus.

The three library collections total over 2 million volumes. Subscriptions to more than 35,000 periodicals and serials, largely of scholarly content, are maintained at the libraries. The Z. Smith Reynolds Library holds over 1.7 million volumes in the general collection, over 400,000 e-books, over 1 million titles in its microtext collection, and nearly 25,000 media items. As a congressionally designated selective federal depository and depository of North Carolina government information, the ZSR Library holds nearly 100,000 government documents. The Professional Center Library holds over 180,000 volumes and the Coy C. Carpenter Library holds over 150,000 volumes. The three libraries share an online catalog, which also provides access to electronic resources, journals and databases, all accessible via the campus network and on the Internet. Through interlibrary loan service, students, faculty and staff may obtain materials from other libraries at no charge. Carpenter Library charges everyone for ILLs (unlike ZSR). In addition, Wake Forest University faculty members have borrowing privileges and on-site access to the collections of some of the most important research libraries in North America.

Bowman Gray Campus

The Coy C. Carpenter Library is the principal learning resource serving the academic needs of the faculty, staff, and student body of the Wake Forest University School of Medicine. The Library contains extensive collections in all of the medical and surgical specialties and the basic sciences, as well as collections in nursing and allied health.

Domestic and foreign periodicals, textbooks, audiovisuals, and computer software are included.

The Carpenter Library's website, www.wakehealth.edu/library, offers access to Medline, UpToDate, Journal Citation Reports, Natural Medicines Comprehensive Database, Micromedex, PsycINFO, and Web of Science, as well as over fifty other bibliographic and full text databases. Over 3,000 electronic journals and 200 textbooks are also available. Specific collections deal with the written and oral history of the medical school, the history of neurology, and the Suzanne Meads Art in Medicine Collection. The library produces the Faculty Publications Database which contains nearly 25,000 citations to WFUSM-authored journal articles, books, and book chapters.

The Library provides assistance to graduate students as they complete the Graduate School's requirement to archive an electronic full-text copy of their thesis or dissertation in Wake Forest University's institutional repository, WakeSpace.

Computer classroom facilities for individual and group instruction are available. The Library offers instruction in individual databases (e.g. Reference Manager, EndNote), software (Microsoft Word, PowerPoint), and on Internet browsers, search engines, and research resources. The library has over ninety connections to the Academic Network for faculty and student ThinkPad users as well as a wireless network. The Library is open seven days a week, all year.

Reynolda Campus

The Z. Smith Reynolds Library provides access to a number of digital current awareness tools to help faculty stay up-to-date in their fields of interest. Photocopy services and campus delivery of books, media, and ILL materials are provided to faculty as well. Faculty may place course materials and readings on reserve, with electronic reserve options available. Faculty participate in collection development by recommending purchases through library liaisons, faculty library representatives, and academic department chairs. Faculty members, along with students, serve on the Library Planning Committee. Library services tailored for faculty are outlined at <http://zsr.wfu.edu/faculty.html>.

The Z. Smith Reynolds Library provides comprehensive reference and research services including assistance with directed and independent

research and online searching, discipline-related library instruction, general library orientation, tours, and a one-credit elective course entitled "Accessing Information in the 21st Century." Reference tools are available in electronic and print formats.

Special collections in the Z. Smith Reynolds Library include the Rare Books and Manuscripts Collection and the Ethel Taylor Crittenden Baptist Historical Collection. The Rare Books and Manuscripts Collection, greatly enhanced by the donation of rare and fine books of the late Charles H. Babcock, emphasizes American and British authors of the 19th and 20th centuries. Among the collections are works of Mark Twain, Gertrude Stein, William Butler Yeats, T.S. Eliot and the publications of the Hogarth Press. The extensive Anglo-Irish literature collection includes the Dolmen Press Archive. The archive of alumnus Harold Hayes, editor of *Esquire* magazine in the 1960s–70s, and the Maya Angelou works for theater, television and screen are maintained in the special collections. The Ethel Taylor Crittenden Baptist Historical Collection contains significant books, periodicals, manuscripts, and church records relating to North Carolina Baptists, as well as the personal papers of prominent ministers, educators, and government officials with ties to Wake Forest College/University. The Wake Forest College/University Archive is maintained in the library as well.

The libraries are equipped for wireless Internet access. Facilities in the Z. Smith Reynolds Library include "The Bridge," a new collaborative service between Information Systems and the library. Faculty, students and staff can bring their university issued laptops for repair. The space also offers a multimedia lab and mini video studio. The library has ten group study rooms that are equipped with SmartBoard technology. These rooms can be booked online at zsr.wfu.edu/studyrooms. In addition, 90 locking study carrels located throughout the Reynolds stacks may be reserved by graduate students. On the fourth floor of the Reynolds wing, a 120 seat auditorium hosts lectures and DVD viewings and the adjacent Media Center contains a browsable collection of nearly 10,000 DVDs and equipment to view them individually or in groups.

The libraries are open continuously during the fall and spring semesters, 24 hours a day from 10 a.m., Sunday morning through Friday at 7 p.m. Saturday the library is open an additional 9 hours. There are two 24-hour study rooms located near

the entrance to the library that may be accessed by keycard any-time, including when the library is closed. The study room on one side of the Z. Smith Reynolds Library houses a Starbucks.

For more information on the libraries visit:

Z. Smith Reynolds Library

<http://zsr.wfu.edu>

Professional Center Library

<http://pcl.wfu.edu>

Coy C. Carpenter Library

<http://www.wfubmc.edu/Library>

Information Technology Academic Computing

Bowman Gray Campus

The Office of Academic Computing is dedicated to the development and support of technology innovations in graduate education. Its mission is to provide the infrastructure for faculty and students to effectively utilize technologies to augment the lifelong learning process. A key role of the department is to facilitate basic understanding with regard to the uses of technology, not only within education but also within the workplace.

The department has developed a ubiquitous computing environment, focusing on technology standards in hardware, software, and networking. The main strategic initiative has been the development of a Web-based curriculum for the individual programs of the Graduate School. The Web-based curriculum provides an organization framework for the digitized lectures and course materials of each program, education-oriented Web sites, schedules, collaborative discussions, and links to specialty content application.

Incoming graduate students are issued a new ThinkPad through the University. The computer is issued to the student during the orientation week and remains the property of the Graduate School until graduation.

The Office of Academic Computing provides technical support for hardware and software issues related to the ThinkPad computers and electronic curriculum. During the hours of 8 a.m. to 5 p.m. Monday through Friday, students can utilize the services of three technical support analysts. After

hours technical services are available through the Information Services Help Desk at 716. HELP (4357). In addition to the technical support functions, the office also provides services to the faculty for the development of teaching applications and assistance with the digitization of curriculum content. Three software developers are employed for this specific purpose.

The laptop computers contain a standard suite of powerful programs that allow students easy access to research and class materials and offer the ability to interact with faculty, staff, and other students through the campus network. The programs include Microsoft Office, electronic mail, Internet, and library browsing, research, analytical, and developmental tools. A large variety of instructional, classroom, and research resources are accessible through the campus network.

Wake Forest has a gigabit Ethernet connection to the Internet. Wake Forest is also a key member of Internet 2, which is focused on providing advanced network technologies, and the North Carolina Research and Education Network (NCREN), which provides statewide educational programs.

Reynolda Campus

Information Systems supports the instruction, research, and administrative needs of the Reynolda Campus of Wake Forest University. The campus computer network offers high-speed wired and wireless connectivity from all campus buildings.

Prior to the beginning of classes, Wake Forest University provides new full-time graduate students with Wake Forest-owned laptops. This practice does not include the Visiting International Faculty Program (VIF) or the Documentary Film Program (DOC). Information Systems provides service and support for the ThinkPad and the standard software that Wake Forest licenses for use by students. Maintenance warranty against manufacturer's defects is provided for the notebook computers for a limited time. Students are responsible for the care of the computer and will be subject to full replacement cost for loss or damage not covered by warranty.

These notebook computers contain a standard suite of powerful programs that allow students easy access to research and class materials and offer the ability to interact with faculty, staff, and other students through the campus network. Software

programs include Microsoft Office, Adobe Acrobat and digital media tools, and e-mail and Internet applications like Mozilla and Adobe Dreamweaver. A large variety of instructional, classroom, and research resources are also available. These include online resources, databases, and electronic journals provided by the Z. Smith Reynolds Library. The Library's online resources can be accessed from all campus buildings via the campus network, or from anywhere via the Web.

Information Systems maintains an extensive array of online information systems that support University admissions, student registration, grade processing, payroll administration, accounting services, and many other administrative and academic applications. In addition, the Wake Forest Information Network (WIN) provides the University community with features like faculty, staff, and student directories; an alumni directory and career networking service; online class registration; and vehicle registration.

Students also have access to computing resources outside the University. The University is a member of the Inter-University Consortium for Political and Social Research (ICPSR), located at the University of Michigan. Membership in ICPSR provides faculty and students with access to a large library of data files, including public opinion surveys, cross-cultural data, financial data, and complete census data. The University is also a member of EDUCAUSE, a national consortium of colleges and universities concerned with computing issues.

The University has an extensive collection of computing facilities serving both academic and business needs. An extensive set of LINUX and Windows-based systems provide for business, messaging, systems management, Internet, intranet, courseware, research, and file and print services for the University. A 182-node LINUX supercomputing cluster with 1300 processors and 60TB of storage provides supercomputing services for physics, biotechnology, mathematics, computer science, and other scientific research. These systems are available to students, faculty, and staff 24 hours a day through the Wake Forest University network or other ISP connectivity. All connections are protected by VPN and firewalls.

Wake Forest's network infrastructure includes a gigabit Ethernet backbone, 100 megabit switched connectivity to the desktop, and pervasive,

802.11a/g wireless connectivity in all campus buildings. Wake Forest has a gigabit Ethernet connection to the Winston-Salem RPOP (regional point of presence) for Internet access. This RPOP connects the University to the North Carolina Research and Education Network (NCREN), the Internet service provider for the majority of North Carolina colleges and universities. Through this connection, Wake Forest has access to additional extensive supercomputing facilities located throughout the state of North Carolina as well as access to all the premiere research networks in the world, including Internet2 and the National Lambda Rail. Wake Forest works closely with NCREN on other advanced network and Internet technologies.

Information Systems provides assistance online at <http://help.wfu.edu>, by telephone at xHELP (4357), and supports walk-in customers in The Bridge located on the main floor of the Z. Smith Reynolds Library. The Bridge provides assistance with information technology services including multimedia, filming, computer repair, and equipment loans and purchases. For more information about The Bridge visit <http://zsr.wfu.edu/bridge>.

Recognition and Accreditation

Wake Forest University is accredited by the Commission on Colleges of the Southern Association of Colleges and Schools to award bachelor's, master's, and doctoral degrees. Contact the Commission on Colleges at 1866 Southern Lane, Decatur, Georgia 30033-4097 or call 404.679.4500 for questions about the accreditation of Wake Forest University. The Commission should only be contacted if there is evidence that appears to support significant non-compliance with a requirement or standard.

The Wake Forest University School of Medicine is a member of the Association of American Medical Colleges and is fully accredited by the Liaison Committee on Medical Education, the joint accrediting body of the Association of American Medical Colleges and the American Medical Association. The School of Law is a member of the Association of American Law Schools and is listed as an approved school by the Council of the Section of Legal Education and Admissions to the Bar of the American Bar Association and by the Board of Law Examiners and the Council of the North Carolina State Bar. The Babcock Graduate School

of Management and the Wayne Calloway School of Business and Accountancy are accredited by the AACSB—The Association to Advance Collegiate Schools of Business. The Babcock Graduate School is accredited by the European Foundation for Management Development. The program in counseling leading to the master of arts degree is accredited by the Council for Accreditation of Counseling and Related Educational Programs. The School of Divinity is accredited by the Association of Theological Schools in the United States and Canada (ATS)

Wake Forest University is a member of many institutional organizations and associations at the national, regional, and statewide levels, including the following: the American Council on Education, the Association of American Colleges, the National Association of Independent Colleges and Universities, the Council of Graduate Schools, the Commission on Colleges of the Southern Association of Colleges and Schools, the Southern Universities Conference, the Conference of Southern Graduate Schools, Oak Ridge Associated Universities, the North Carolina Conference of Graduate Schools, the North Carolina Association of Colleges and Universities, the North Carolina Department of Public Instruction, and the North Carolina Independent Colleges and Universities. In addition, many offices of the University are members of associations which focus on particular aspects of University administration.

There is an active chapter of the American Association of University Professors on campus.

Oak Ridge Associated Universities

Since 1993, students and faculty of Wake Forest University have benefited from its membership in Oak Ridge Associated Universities (ORAU). ORAU is a consortium of ninety-eight colleges and universities and a contractor for the U.S. Department of Energy (DOE) located in Oak Ridge, Tennessee. ORAU works with its member institutions

to help their students and faculty gain access to federal research facilities throughout the country; to keep its members informed about opportunities for fellowship, scholarship, and research appointments; and to organize research alliances among its members.

Through the Oak Ridge Institute for Science and Education (ORISE), the DOE facility that ORAU operates, undergraduates, graduates, postgraduates, as well as faculty enjoy access to a multitude of opportunities for study and research. Students can participate in programs covering a wide variety of disciplines including business, earth sciences, epidemiology, engineering, physics, geological sciences, pharmacology, ocean sciences, biomedical sciences, nuclear chemistry, and mathematics. Appointment and program length range from one month to four years. Many of these programs are especially designed to increase the numbers of under-represented minority students pursuing degrees in science- and engineering-related disciplines. A comprehensive listing of these programs and other opportunities, their disciplines, and details on locations and benefits can be found at www.ornl.gov/orise/educ.htm, or by calling the contact below.

ORAU's Office of Partnership Development seeks opportunities for partnerships and alliances among ORAU's members, private industry, and major federal facilities. Activities include faculty development programs, such as the Ralph E. Powe Junior Faculty Enhancement Awards, the Visiting Industrial Scholars Program, consortium research funding initiatives, faculty research, and support programs as well as services to chief research officers.

For more information about ORAU and its programs, contact Lorna G. Moore, dean of the Graduate School of Arts and Sciences, ORAU Councilor for Wake Forest University or Monnie E. Champion, ORAU corporate secretary, at 865.576.3306; or visit the ORAU at www.ornl.gov.

Application materials and an online application submission process are available at <http://graduate.wfu.edu>

The Graduate School

IN ACCORD WITH THE PREVAILING
CUSTOM AMONG AMERICAN COLLEGES
DURING THE ANTEBELLUM PERIOD,
WAKE FOREST GRANTED HONORARY
MASTER'S DEGREES TO SELECTED ALUMNI.

By 1862, when the College closed temporarily because of the Civil War, twenty-nine such degrees had been awarded. The first announcement of a program of study leading to an earned graduate degree at Wake Forest was made in 1866. Between 1871, when the first degrees earned under the plan were awarded to John Bruce Brewer (grandson of Samuel Wait) and Franklin Hobgood, and 1951, 383 master of arts and master of science degrees were granted. In 1949 the School of Arts and Sciences discontinued admitting applicants for the master of arts degree because the rapid increase in the size of the undergraduate student body following World War II had overloaded the faculty. The School of Medicine did not interrupt its graduate program. The first master of science degree conferred by the school after it moved to Winston-Salem was awarded in 1943, and the degree was offered regularly thereafter by the departments of anatomy, biochemistry, microbiology, pharmacology, and physiology.

During the fifteen years the College and the School of Medicine were located in different towns, the study of graduate education continued on both campuses. The self-study report adopted by the faculty of the School of Arts and Sciences immediately prior to its move to Winston-Salem recommended that graduate study leading to the master's degree be resumed as soon as practicable. In 1958 the administration of the School of Medicine, in view of an increasing demand for graduate instruction in basic medical and clinical sciences, appointed a Committee on Graduate Studies for the purpose of reorganizing the graduate program.

As a result of these two parallel studies and in recognition of the need for an institution-wide

approach to graduate education, the trustees, on January 13, 1961, established the Division of Graduate Studies and authorized it to grant the master of arts degree in the School of Arts and Sciences and the master of science and doctor of philosophy degrees in the School of Medicine. The first PhD degree was awarded in 1964. In 1967 the master of arts in education degree was added to the graduate program in arts and sciences. A program, leading to the master of arts in liberal studies, was begun in the summer of 1987. The first PhD program on the Reynolda campus was begun in 1970.

Statement of Purpose of the University

Following is the official statement of the purposes and objectives of the University:

Wake Forest is a University dedicated to the pursuit of excellence in the liberal arts and in graduate and professional education. Its distinctiveness in its pursuit of its mission derives from its private, coeducational, and residential character; its size and location; and its Baptist affiliation. Each of these factors constitutes a significant aspect of the unique character of the institution.

The University is comprised of Wake Forest College, the Graduate School, the School of Law, the Wake Forest University School of Medicine, the School of Divinity and the Schools of Business. It seeks to honor the ideals of liberal learning, which entail commitment to transmission of cultural heritages; teaching the modes of learning in the basic disciplines of human knowledge; developing the critical appreciation of moral, aesthetic, and religious values; advancing the frontiers of knowledge through in-depth study and research; and applying and using knowledge in the service of humanity.

Wake Forest has been dedicated to the liberal arts for over a century and a half; this means education in the fundamental fields of human

knowledge and achievement, as distinguished from education that is technical or narrowly vocational. It seeks to encourage habits of mind that ask “why,” that evaluate evidence, that are open to new ideas, that attempt to understand and appreciate the perspectives of others, that accept complexity and grapple with it, that admit error, and that pursue truth. Wake Forest College has by far the largest student body in the University, and its function is central to the University’s larger life. The College and the Graduate School are most singularly focused on learning for its own sake; they, therefore, serve as exemplars of specific academic values in the life of the University.

Beginning as early as 1894, Wake Forest accepted an obligation to provide professional training in a number of fields as a complement to its primary mission of liberal arts education. This responsibility is fulfilled in the conviction that the humane values embodied in the liberal arts are also centrally relevant to the professions. Professional education at Wake Forest is characterized by a commitment to ethical and other professional ideals that transcend technical skills. Like the Graduate School, the professional schools are dedicated to the advancement of learning in their fields. In addition, they are specifically committed to the application of knowledge to solving concrete problems of human beings. They are strengthened by values and goals which they share with the College and Graduate School, and the professional schools enhance the work of these schools and the University as a whole by serving as models of service to humanity.

Wake Forest was founded by private initiative, and ultimate decision-making authority lies in a privately appointed Board of Trustees rather than in a public body. Funded to a large extent from private sources of support, Wake Forest is determined to chart its own course in the pursuit of its goals. As a coeducational institution it seeks to “educate together” persons of both sexes and from a wide range of backgrounds—racial, ethnic, religious, geographical, socioeconomic, and cultural. Its residential features are conducive to learning and to the pursuit of a wide range of cocurricular activities. It has made a conscious choice to remain small in overall size; it takes pride in being able to function as a community rather than a conglomerate. Its location in the Piedmont area of North Carolina engenders an ethos that is distinctively

Southern, and more specifically North Carolinian. As it seeks to broaden further its constituency and to receive national recognition, it is also finding ways to maintain the ethos associated with its regional roots.

Wake Forest is proud of its Baptist and Christian heritage. For more than a century and a half, it has provided the University an indispensable basis for its mission and purpose, enabling Wake Forest to educate thousands of ministers and lay people for enlightened leadership in their churches and communities. Far from being exclusive and parochial, this religious tradition gives the University roots that ensure its lasting identity and branches that provide a supportive environment for a wide variety of faiths. The Baptist insistence on both the separation of church and state and local autonomy has helped to protect the University from interference and domination by outside interests, whether these be commercial, governmental, or ecclesiastical. The Baptist emphasis upon revealed truth enables a strong religious critique of human reason, even as the claims of revelation are put under the scrutiny of reason. The character of intellectual life at Wake Forest encourages open and frank dialogue and provides assurance that the University will be ecumenical and not provincial in scope, and that it must encompass perspectives other than the Christian. Wake Forest thus seeks to maintain and invigorate what is noblest in its religious heritage.

The Mission of the Wake Forest University Graduate School

The mission of the WFU Graduate School of Arts and Sciences is to train and mentor future leaders in research, teaching and innovation for serving humanity. This embodies the Graduate School’s vital role as an engine of discovery that fuels the nation’s scholarly and creative enterprise. The Graduate School contributes to the academic reputation of the university by educating the next generation of teachers and scholars and by providing mentors and role models for educating undergraduates. A strong graduate program also helps support faculty research and is critical for faculty recruitment and retention.

We seek to instill in our students a sense of professionalism, which includes the ethical behavior inherent in their professional role, as well as respect for their colleagues, their

field, and for society as a whole. We want our students to be critical, independent thinkers and good citizens. They should be motivated to apply their scholastic efforts to enlighten and improve the well being of society. Thus the Graduate School is a key link for collaboration between departments and schools and for achieving WFU's goal of becoming a collegiate university and major academic medical center.

Our values are steadfast and consist of critical thinking, service, diversity, discovery, mentoring, and ethics. These are integral to all our activities in the classroom, the laboratory or other research environments, the broader communities of which we are a part.

Our vision is for the Graduate School to be a diverse community of excellence.

We achieve our vision and fulfill our mission through strategic activities that build pillars of excellence in:

- Student experience, to create an optimized learning and mentoring experience that prepares students to lead in any career path.

- Research, to provide high-quality research partnerships for promoting innovation, discovery and creation of value to the community.
- Faculty and staff support, to enable seamless, effective, aligned services for maximizing time and resources for instruction and research.
- Internal and external communication that celebrates the prominence and value of the Graduate School and the University.

Administration

The Graduate School is administered by a dean, two associate deans, and a Graduate Council composed of ex-officio administrative officials, twelve faculty members elected by the Graduate School faculty, and two graduate students elected by the Graduate Student Association. Six of the twelve are members of the College of Arts and Sciences (Reynolda campus) and six are members of the Wake Forest University School of Medicine faculty (Bowman Gray campus).

Application materials and an online application submission process are available at <http://graduate.wfu.edu>

Procedures

ALL STUDENTS ARE RESPONSIBLE FOR FAMILIARIZING THEMSELVES WITH THE PORTIONS OF THIS BULLETIN THAT PERTAIN TO THEIR COURSE OF STUDY. STATEMENTS CONCERNING COURSES AND EXPENSES ARE NOT TO BE REGARDED AS IRREVOCABLE CONTRACTS BETWEEN THE STUDENT AND THE INSTITUTION. THE UNIVERSITY RESERVES THE RIGHT TO CHANGE THE SCHEDULE OF CLASSES AND THE COST OF INSTRUCTION AT ANY TIME WITHIN THE STUDENT'S TERM OF RESIDENCE.

Dates for Applying

Students normally matriculate at the beginning of the fall semester. Students in the Master of Arts in Education Program matriculate in early June. Please visit <http://graduate.wfu.edu/admissions/checklist/app-deadlines.html> for complete information.

How to Apply

Application materials and information on the application process are available on the Web at <http://graduate.wfu.edu/admissions>.

Financial Assistance

On the Reynolda campus, full-tuition scholarships, partial-tuition scholarships, fellowships, graduate assistantships, teaching assistantships, and research assistantships are available to qualified students. Assistantships and fellowships include a tuition scholarship as part of the grant. An assistantship includes a tuition scholarship plus compensation for services rendered. Assistants work from 12 to 15 hours per week and carry a normal course load.

Acceptance of a fellowship (Bowman Gray campus), teaching assistantship, or research assistantship carries with it the obligation to perform duties assigned by the student's department. Unsatisfactory performance or failure to complete these assigned duties will result in the withdrawal of all financial aid. In this case, students may be allowed to continue the program by paying the remainder of their own tuition on a pro rata basis, provided they are in good academic standing, or they may be dropped from the program. Exceptions to this regulation may be made on an individual basis involving extraordinary circumstances and with the recommendation of the student's department.

Assistantships and fellowships are potentially renewable, but the total number of years a student working toward the master's degree may receive support may not exceed two. Information on financial aid awards will be included in the offer of admissions letter.

Some students who receive graduate assistantships may be assigned duties outside the department of study.

The residence life and housing office on the Reynolda Campus has a limited number of hall director and compliance advisor positions available to qualified graduate students. Please note that tuition scholarships may be available for the hall director position. However, such scholarships are not available to students enrolled in divinity, law, liberal studies, MBA, education, and biomedical programs. Interested students are urged to contact the Office of Residence Life and Housing for more information by calling 336.758.5185; e-mailing housing@wfu.edu; or visiting the employment section of www.wfu.edu/housing.

The Barn, a venue for student gatherings of a social nature, has a small number of positions available for graduate students to assist with event and program management. Interested students are encouraged to contact campus life at 336.758.4070 or campuslife@wfu.edu.

A number of full-tuition scholarships and research grants are available for Reynolda continuing students for the summer sessions. Interested persons should contact their respective departments.

Financial support for students on the Bowman Gray campus is provided from various sources, including dean's fellowships, graduate fellowships, and tuition scholarships. In addition, many students are supported as research assistants from externally funded sources. Fellowships include tuition scholarships.

The Louis Argenta Physician-Scientists Scholar Award Scholarship seeks to develop leaders in translational science by providing funds to support MD/PhD students during their research years. The new calling for the physician-scientist is to lead these diverse teams. This scholarship will be awarded to incoming students that have outstanding interpersonal skills, superior communication, and the potential to develop into a leader in translational science.

The Norman M. Sulkin Scholarship Fund provides scholarship assistance to students in the neurobiology and anatomy PhD program.

The Camillo Artom Scholarship provides annual scholarship grants to one or more students enrolled in programs leading to the MD or PhD degrees with special preference given to students seeking a degree in biochemistry and molecular biology.

Herbert C. Cheung PhD Award provides a cash award to recognize an outstanding graduate student in the Department of Biochemistry and to promote excellence in research in the broad field of biochemistry.

The Sandy Lee Cowgill Memorial Scholarship Fund provides scholarships to at least two students, the first of whom shall be enrolled in the MD program and the second of whom may be enrolled in the MD or PhD program, with preference given to a student in biochemistry and molecular biology.

The Lucy Robbins Fellowship Fund provides a scholarship for a current fourth-year graduate student conducting cancer-related research.

Reynolda graduate students who are interested in the Guaranteed/Insured Student Loan Program

should request information from their state agency or the student financial aid office. North Carolinians may receive applications from College Foundation Inc., P.O. Box 12100, Raleigh, NC 27605-2100. Bowman Gray campus students may contact the financial aid office.

A student must be in good academic standing and must be making satisfactory progress toward the degree to be eligible for a student loan. Unclassified (non-degree seeking) and provisionally accepted students are not eligible for financial aid.

Admission

Eligibility. Undergraduate seniors and graduates of accredited U.S. colleges and universities or recognized foreign institutions may apply for admission to the Graduate School for study on the Reynolda campus or the Bowman Gray campus. Undergraduates must complete their degree requirements prior to entering the Graduate School. Medical students who have satisfactorily completed, or will complete by the end of the spring semester, at least one year of the medical curriculum may apply for admission to the Graduate School. The Graduate School also accepts applications from holders of the MD, DDS, or DVM degrees, or from candidates for these degrees who will have satisfactorily completed the prescribed medical curriculum prior to matriculation in the Graduate School.

Whatever their previous academic training may have been, all applicants should have superior records. This requirement is usually interpreted as at least a B average or standing in the upper quarter of the class or both.

Graduate Record Examinations. All applicants (except for the combined MD/PhD program) are required to submit official scores on the General Test and the Subject Test* of the Graduate Record Examinations (GRE) administered by the Educational Testing Service, P.O. Box 6000, Princeton, New Jersey 08541-6000 (www.ets.org). Applicants to the bioethics program may qualify for a GRE waiver upon demonstration of significant relevant professional experience. Additional information is located under Bioethics Program Information. Usually these examinations are taken in the fall of the student's senior year. When applying to take the GRE, applicants should enter the Wake Forest University Graduate School code 5885 for programs of study on

the Reynolda campus, or 5920 for programs of study on the Bowman Gray campus. Test scores will be received from Education Testing Service.

**The GRE Subject Test is recommended but not required for the Departments of Chemistry, English, Physics, and Psychology. The other Reynolda campus departments and Bowman Gray campus programs do not require the subject test.*

Test of English as a Foreign Language.

International students (those who did not graduate from a college or university within the U.S.) must submit the Test of English as a Foreign Language (TOEFL) scores; the minimum total score is 550 (paper-based test), 213 (computer-based test) or 79-80 (Internet-based test). The TOEFL bulletin of information and registration form can be obtained at American embassies and consulates, offices of the United States Information Service, United States educational commissions and foundations abroad, and at bi-national centers. Students unable to obtain a bulletin from one of the above should write to: Test of English as a Foreign Language, P.O. Box 6155, Princeton, New Jersey 08542-6155, USA or visit www.toefl.org. Administrations of TOEFL are coordinated with the GRE and are available in most countries. Correspondence should be initiated at least three months before the testing date. When applying to take the TOEFL, applicants should enter the Wake Forest University Graduate School code 5885 for programs of study on the Reynolda campus, or 5920 for programs of study on the Bowman Gray campus. Test scores will be sent from Educational Testing Service.

International English Language Testing System. IELTS is jointly managed by the British Council, IDP:IELTS Australia, and the University of Cambridge ESOL Examinations. The IELTS is available at 270 test centers worldwide. The minimum score on the IELTS is 6.5. To obtain information regarding this test and the centers, visit www.ielts.org.

Personal Interviews. Although not required of all students, personal interviews are encouraged and may be specified as a requirement for some programs. For more information, contact the program director.

Transfer Students. Applicants for the master's degree who have completed a portion of their graduate training in another institution are eligible for admission but may not transfer for credit more than six semester hours of coursework. The minimum grade allowed for transferring courses in is B. This limitation does not apply to applicants for the PhD degree. An official release letter is required from the applicant's current institution.

Admission of Students with Disabilities

Wake Forest University will consider the application of any qualified student, regardless of disability, on the basis of the selection criteria established by the University which include personal and academic merit. Upon matriculation, all students will be required to meet the same standards for graduation.

The University endeavors to provide facilities which are in compliance with all laws and regulations regarding access for individuals with disabilities. Additionally, special services are available to reasonably accommodate students with disabilities. For more information on assistance for graduate students, please contact Van D. Westervelt, director of the Learning Assistance Center at 336.758.5929 or refer to Disability Services under Campus Life at the Wake Forest website.

Admission Categories

Regular Status in a Degree Program. A person with a superior undergraduate record (at least a B average or upper quarter of the class and with the appropriate courses), satisfactory GRE scores, TOEFL or IELTS scores (for international students), and good recommendations may apply for regular admission.

Provisional Status in a Degree Program. Those who may be awaiting GRE, TOEFL or IELTS scores at the time of application, or have grades slightly below those specified for regular admission, may be granted provisional admission. Provisional status is limited to not more than one semester of full-time study or its equivalent in part-time study.

Unclassified Non-Degree Graduate Status. Applicants seeking courses for graduate credit but not wishing to work for a graduate degree may apply

for admission as unclassified or non-degree status. Applicants are required to complete an application, submit a \$65 application fee, meet the immunization requirements, and submit an official transcript showing a baccalaureate degree at least one month prior to matriculation. Instructor approval is required for each course prior to enrollment.

Classification of Students

Full-Time Status. A student who devotes full-time to a graduate program as outlined by his or her faculty committee and is in full-time geographic residence with a minimum of nine semester hours of coursework, including thesis research, is considered a full-time student. Students registered as “thesis only” or “graduate fee only” may be considered full-time.

Part-Time Status. A student registered for less than the above amount of coursework is considered a part-time student. Each department will determine whether it is possible to pursue a degree on a part-time basis.

2011-2012 Tuition and Fee Schedule

Full-time Tuition	\$32,208
Fall 2011 and Spring 2012 (minimum 9 hours)	
Part-time Tuition per hour	\$1,147
Audit Fee per hour (part-time students)	\$100
Summer Session	
Reynolda Campus (per hour)	\$726
Bowman Gray Campus (semester)	\$300
Visiting International Faculty (per hour)	\$192

The statements concerning expenses are given as information to prospective students. They should not be regarded as forming a contract between the student and the University. The costs of instruction and other services outlined here are those in effect on the date this material was printed. Wake Forest University may change the cost of instruction and other services at any time.

Students on either campus not enrolled in classes but using University facilities or faculty time for such projects as the completion of a thesis

are required to register and pay a graduate student fee of \$30 per semester or \$15 for each term of the summer session. Students must be enrolled for the semester in which they graduate.

During both the academic year and the summer session, full-time graduate students on either campus may take graduate courses on the other campus without additional tuition.

Student Graduation Fees. Students on either campus pay a fee at the time of graduation. The fee for all students is \$55.

University Fees. A student health fee of \$316 is charged for all full-time Reynolda campus students. A transcript fee of \$50 is charged to newly matriculating students on the Reynolda campus.

Tuition Concession. There is a tuition concession plan for faculty and staff of the University and for the spouses of faculty and eligible staff members. For further information, contact the human resources office. The Graduate School grants a one-half tuition rate for educators teaching full-time in public schools or state-approved, non-public schools. This policy covers only educators who teach either in grades kindergarten through 12th or in community college institutions.

Graduate students enrolled for full-time and part-time status are entitled to full privileges regarding libraries, laboratories, athletic contests, student publications, the Student Union, the University Theatre, the Secret Artists Series of Wake Forest University, and the Student Health Service.

During the academic year, all students, full- and part-time, receive tuition refunds according to the following schedule. This policy applies to students dropping courses as well as to those withdrawing. Withdrawals must be official and students must turn in their identification cards and laptop computer before claiming refunds.

Graduate students who are recipients of Title 4 federal financial aid (Pell Grants, SEOG, FWS, Perkins Loans, Stafford Loans and PLUS Loans) should refer to the 2011-12 *Wake Forest Undergraduate Bulletin* for the Return of Program Funds policy.

Schedule of Adjustments for Withdrawal

Official Withdrawal

Before classes begin	100% of tuition less deposit
First week of classes	90%
Second week of classes	75%
Third week of classes	50%
Fourth week of classes	30%
Fifth week of classes	20 %

If the University deems it necessary to engage the services of a collection agency or attorney to collect or to settle any dispute in connection with an unpaid balance on a student account, the student will be liable for all collection agency and/or attorney's fees, reasonable expenses, and costs incurred.

Housing Services

The Graduate School does not require that students live in University housing. Most students make their own arrangements for housing off campus. The Office of Residence Life and Housing (Benson 101) serves as an information center for individuals who wish to advertise rooms, apartments, and houses for rent or sale. It also provides a place for students to list information if they are interested in finding a roommate to share expenses. Off-campus facilities are not screened. The University serves only as an information source and does not assume responsibility for placement, lease agreements, or landlord-tenant relations.

Graduate students who live in University housing are expected to follow the regulations and conditions governing occupancy as stated in the lease or contract agreement. Bowman Gray campus students may apply for a Medical Foundation apartment or secure housing in other facilities near the Medical Center.

It is advisable to make housing arrangements as early as possible as space is very limited for both single and married students. For information regarding available off-campus University housing on the Reynolda campus, students should contact Hope Jordan, portfolio manager, 336.759.1123.

Food Services

The Wake Forest dining service offers a variety of locations where students can use their Deacon OneCard. Seven dining locations on the

Reynolda campus offer a variety of food options and atmospheres: The Fresh Food Company at Reynolda Hall, The Benson Food Court, Shorty's, The Magnolia Room, The IS Food Court, and three convenience stores (The Sundry, Polo Area Sundry, and Bodega). Cafeterias and fast-food services are also available on the Bowman Gray campus.

The Deacon OneCard is a declining balance account available with your student ID card. Money can be added to the account during the semester with a deposit of \$25 or more cash, check, or money order or \$100 or more with MasterCard or Visa.

For additional information, please contact ARAMARK Dining Services, P.O. Box 7393, Winston-Salem, NC 27109-7393, by telephone 336.758.5607 or stop by the ARAMARK offices at 31C Reynolda Hall.

Student Health Service

Bowman Gray Campus

Students are assigned to physicians in the Department of Family and Community Medicine for provision of primary care services. Spouses and dependent children may request the services of the assigned physician.

Members of the faculty serve as student's physicians. Clinics are held Monday through Friday, by appointment, for preventive and therapeutic services. Physicians are available for emergencies twenty-four hours a day, seven days a week, through an answering service. The student's medical insurance company will be billed for *all* visits. A co-pay must be submitted at the time of service.

Students are *required* to have adequate health insurance. Any charges generated that are not covered by the student's insurance policy will be the personal responsibility of the student. Students may enroll in the student injury and sickness insurance plan. Information on this plan will be provided by the Graduate School office.

Prior to matriculation, each student is *required* to complete a health assessment questionnaire, have a complete physical exam, and have updated immunizations at his/her expense.

The Medical Center Employee Health Services will have the responsibility for monitoring compliance with the below mentioned immunization

requirements as well as being responsible for ongoing tuberculosis screening done on a yearly basis. Employee Health Services also will manage any blood and body fluid exposures, as well as provide acute care clinics at no charge.

Immunization Policy

Bowman Gray Campus

Wake Forest University and North Carolina State law require that all new, transfer, readmit, unclassified, or visiting students, except those with a valid exemption, submit certification of certain immunizations PRIOR TO REGISTRATION.

Documentation should be on or attached to the completed immunization form provided by the Medical Center Employee Health Services. Acceptable documentation is (1) the signature of the appropriate official(s) having custody of the immunization records, such as a physician or county health department official, or (2) a certificate from the student's former school containing the approved dates of immunizations, or (3) photocopies of the original records.

Tetanus and Diphtheria (Td) or Tetanus/Diphtheria/Pertussis (Tdap). Students must document a booster less than ten years old. Tdap preferred.

Rubeola (Measles). Students must document two doses of live virus measles vaccine, given at least thirty days apart, on or after their first birthday (after 3/21/63*). If they were born prior to 1/1/57, they must have documentation of a titer indicating that they are immune, or documentation of vaccinations with live virus vaccine.

Rubella (German Measles). Students must document that they have had one dose of live virus vaccine on or after their first birthday (after 6/9/69*), or they must have documentation of a titer indicating they are immune. History of the disease is *not* acceptable.

Mumps. Students must document that they have had two doses of live virus mumps vaccine on or after their first birthday (after 12/28/67*), or provide documentation of a blood test (Mumps IGG) proving immunity.

PPD Tuberculin Skin Test. The test is required; a tine test will not be accepted. The test must have been done after March of this current year. If the student is known to be tuberculin-positive or if the test result is positive, attach record of treatment and chest x-ray results. If the test result is positive, attach record of TST reading with mm value, any treatment received, and chest x-ray report within past 3 years.

Hepatitis B. A three-dose series of the vaccine with a confirmatory positive titer is recommended (not required).

Varicella Titer. A varicella titer result is required—without exception.

** Indicates date the vaccine was licensed by the FDA. Combination vaccines have different licensure dates.*

The North Carolina requirements must be documented within thirty days following enrollment. After that time, unimmunized students cannot attend classes until their immunizations are documented. Please note that the Hepatitis B series requires several months for completion.

Questions regarding these requirements should be directed to Employee Health Services at 336.716.4801.

Student Health Service

Reynolda Campus

The Student Health Service promotes a healthy lifestyle through health education and health maintenance. A physician-directed medical staff offers urgent care, illness care, physical examinations, counseling, limited psychiatric care, allergy injections, immunizations, gynecological services, pharmacy, laboratory, sports medicine clinic, referral to specialists, and medical information and vaccinations related to travel to international destinations. For more information go to www.wfu.edu/shs.

A full staff is available by appointment during clinic hours (fall and spring semesters): 8:30 a.m. to noon; 1:30 to 4 p.m., Monday–Friday and Monday–Thursday during the summer. A limited staff is available for urgent care and observation twenty-four hours a day, 7 days a week, when school is in session during the academic year. The services of the staff are covered by the student health fee. In

addition, there are discounted “fee-for-service” charges for medications, laboratory tests, observation care, and some supplies and services (such as minor surgery). Payment can be made using cash, check, or Deacon Dollars. The charge can also be placed on the student’s account in Financial and Accounting Services. A copy of the statement is given to the student to file with their insurance company.

Health Information Summary

All new, transfer and readmit students are required to have on file in the Student Health Service the *WFU Student Health Service Health Information Summary Form*. It must be received by the Student Health Service before May 1 for summer session, July 1 for new students entering fall semester or before January 1 for new students entering spring semester. The form is available for download at <http://wfu.edu/shs>. This form includes documentation of immunizations required by the University and the State of North Carolina.

Confidentiality. Student medical records are confidential. Medical records and information contained in the records may be shared with therapists and physicians who are involved in the student’s care, and otherwise will not be released without the student’s permission except as allowed by law. Students who wish to have their medical records or information released to other parties should complete a release of information form at the time of each office visit or service.

Class Excuses. The responsibility of excusing students from class rests with the faculty. Consequently the Student Health Service does not issue “excuses” for students. Students who are evaluated at the Student Health Service are encouraged to discuss their medical situations with their professors. A receipt documenting visits is available to students at checkout. Information concerning hospitalization and prolonged illnesses is sent, with the student’s permission, to the appropriate dean

Student Insurance Program Information. Beginning in the fall of 2010, health insurance will be required as a condition of enrollment for full-time students. Students who demonstrate comparable coverage may waive the coverage provided by

Wake Forest University. Information about the policy plan and process instructions can be found at <http://www.wfu.edu/sip>.

Inclement Weather. When the University is closed due to inclement weather, the Student Health Service will have limited staff and will be able to provide care only for injuries and urgent illnesses. Appointments will be rescheduled.

Retention of Medical Records. Student medical records are retained for ten years after the last treatment, after which time they are destroyed. Immunization records are kept longer.

Immunization Policy

Reynolda Campus

Wake Forest University and North Carolina State law (G.S. 130A-152) requires documentation of certain immunizations for students attending a North Carolina college or university. Students must submit certification of these immunizations **PRIOR TO REGISTRATION**. Documentation should be on or attached to the completed *WFU Student Health Service Information Summary Form* provided by the Student Health Service in order to assure correct identification of the student. If you have not received the *Health Information Summary Form* you may download it from the Wake Forest University Student Health Service website (www.wfu.edu/shs/docs/HIS.pdf). Acceptable documentation is a statement signed by the appropriate official(s) having custody of the records of immunization, such as a physician, county health department director or a certificate from a student’s high school containing the approved dates of immunizations. The State statute applies to all students except those registered in off-campus courses only, attending night or weekend classes only, or taking a courseload of four credit hours or less.

The American College Health Association recommendations and North Carolina State law require certification in accordance with the following:

Required:

Tetanus/Diphtheria/Pertussis. Students must document three doses of a combined tetanus diphtheria vaccine (DTaP, Td, or Tdap) of which one must be within 10 years of enrollment and

one of which must have been Tdap (unless the individual has received a booster of other tetanus/diphtheria toxoid within the last 10 years).

Rubeola (Measles). Students must document two doses of live virus measles vaccine given at least thirty days apart, on or after their first birthday unless (a) they have a physician's certificate which states that they have had measles prior to 1/1/94, (b) they were born prior to 1/1/57, or (c) they have documentation of a titer indicating they are immune.

Rubella (German Measles). Students must document that they have had one dose of live virus vaccine on or after their first birthday unless (a) they have documentation of a titer indicating they are immune, or (b) they will be fifty years old before they enroll. History of the disease is *not* acceptable.

Mumps. Students must document two doses of live virus mumps vaccine given at least thirty days apart on or after their first birthday unless (a) they were born before 1/1/57, or (b) they have documentation of a titer indicating they are immune. History of the disease is *not* acceptable.

Polio. Students must document that they have had a trivalent polio vaccine series and a booster on or after their fourth birthday unless they will be eighteen years old or older when they enroll.

Tuberculin Skin Test. The test is required within twelve months of the University registration date if (a) the student has been exposed to tuberculosis or has signs or symptoms of active tuberculosis disease or (b) the student's home country is other than the United States, Australia, New Zealand, Canada, Western Europe, or Japan. If the student is known to be tuberculin-positive or if this test is positive, attach a record of treatment.

Recommended:

Hepatitis B. A three-dose series of the vaccine is recommended by the Centers for Disease Control.

Varicella. The two-dose series is recommended. Discuss with your health provider.

Quadrivalent Human Papillomavirus Vaccine.

A three-dose series.

Immunizations required under North Carolina law must be documented within thirty days following registration. After that time, students with incomplete documentation of immunizations will not be permitted to attend classes. Please note that some series require several months for completion.

Vehicle Registration

All students bringing a motor vehicle to the campus must register the vehicle with the parking and transportation office. Vehicle registration must be completed online. To register, log on to WIN and click on "Personal" at the top of the page. Select the option to "Register your vehicle for a WFU parking decal." A second option is to go to <http://wfu-parking.t2hosted.com>. Vehicle registration is not complete until the parking decal is displayed on the vehicle per instructions printed on the reverse side of the decal.

Full-time resident and commuter students (on-campus commuter permits are limited to 900 for the 2011/2012 academic year and were sold on a first-come, first serve basis beginning April 2011) can purchase a vehicle parking decal for \$500 (to park on campus), \$300 (to park in the off-campus lots at Winston-Salem First or Reynolda Village) or obtain a no-cost decal (to park in the satellite parking lot adjacent to Bridger Field House). The parking decal fee for first-year students is \$300.

Gate protocols have been established to serve as a deterrent to criminal activity on campus and to assist the public with campus information and parking. Visitors and guests entering campus at night (between 10 p.m. and 6 a.m.), will be stopped at the gate to register their vehicles.

The vehicles of students, faculty, staff, and regular vendors entering campus during the hours of gatehouse operation (between 10 p.m. and 6 a.m.) must display a front windshield identification in the form of a decal, a visitor pass, or a hang tag in addition to a parking decal. Failure to register your vehicle or follow proper procedures could result in a referral to the dean of student's office. Please be reminded that all vehicles on campus must obey the North Carolina driving laws and especially be reminded that pedestrians have the right of way.

Procedures to register guest vehicles are available in the Parking Rules and Regulations

brochure. For a brochure and parking map visit www.wfu.edu/facilities/ParkingManagement.html.

Bowman Gray campus students may sign up for paid-monthly parking at orientation. Those who take classes on the Reynolda campus, including audit, or use other facilities, must purchase a parking sticker from the Parking Management Office.

Students are responsible for their visitors. Students will be held financially responsible for citations issued to vehicles driven by family members or by friends who use a WFU/Bowman Gray student's vehicle.

Alternative Transportation

www.sustainability.wfu.edu/campus/transportation
www.wfu.edu/ridethewake

Wake Forest offers a variety of alternatives for students who don't bring a car to campus or who choose to leave their vehicle parked during the school year. Zipcars provide "wheels when you want them" to students 18 and older. Zipcar membership information is available on the Office of Sustainability's website under campus transportation.

Additionally, the campus shuttle program provides free service to several local apartment complexes, around the campus and to downtown Winston-Salem. It operates on a set schedule Monday-Friday when school is in session. An evening shuttle also operates on a set schedule, 7 days a week while school is in session. The evening shuttle provides service to Student Drive and Winston-Salem First lots. The downtown shuttle operates Thursday-Sunday evenings and transports students to and from several downtown locations. A shuttle also runs between the Reynolda and Bowman Gray campuses.

Visit www.wfu.edu/ridethewake for shuttle schedules.

University Identification Cards

Bowman Gray Campus

Arrangement is made with security during orientation for each student to obtain a photo identification card. Students must wear their ID badge at all times while on campus.

Reynolda Campus

All students are required to obtain an ID card and to have it with them at all times while on campus. Cards may be obtained from the Deacon OneCard Office, Room 101, Benson Center, between the hours of 8:30 a.m. to 5 p.m., Monday-Friday. For further information, call 336.758.1949 or email DeaconOneCard@wfu.edu.

Career Services

The Office of Career Services (OCS) offers a full range of career services including job search guidance, internship opportunities, and full-time job listings. Other services include resume consultations and mock interviews.

Students enrolled in graduate programs are encouraged to consult the OCS office as early as possible regarding the services described above.

The Career Services office is located in 8 Reynolda Hall (Reynolda campus). Office hours are 8:30 a.m.-5 p.m., Monday-Friday. Appointments may be made in person or by calling 336.758.5902.

Counseling Centers

Bowman Gray Campus: The Student Wellness Center (SWC)

The Student Wellness Center is located on the Wake Forest Baptist Health Center Campus in temporary quarters on the first floor of the Commons/Nutrition Building (The location will soon be changing to the 8th floor of the Hanes Building). The SWC provides short-term, time limited counseling and consultation, as well as, wellness activities to currently enrolled students on the health center campus. All services are confidential, and no fees are charged to students. The Center offers counseling for a variety of concerns including depression, anxiety, personal adjustment, disordered eating, managing stress, school/life balance, sexuality, and relationship issues. Wellness activities are in the process of being formulated and will include activities such as yoga, mindfulness meditation, fitness, dancing and facilitated discussions related to helping students manage the demands of graduate school. Appointments are available to students from 9 a.m.-7 p.m., Monday-Thursday

and from 9 a.m-5 p.m. on Friday. Wellness activities will be posted on the Student Wellness Center Website Calendar. There is presently no emergency, weekend, or after hours service available to students. To make an appointment, you may contact Jamie Dickey Ungerleider, LCSW, PHD at jungerle@wfubmc.edu or 713-7002.

Reynolda Campus

The University Counseling Center, located in 118 Reynolda Hall (Reynolda Campus), provides short-term, time limited counseling and consultation to currently enrolled Reynolda Campus students. All services are confidential, and no fees are charged to students. The Center offers counseling for a variety of concerns including depression, anxiety, personal adjustment, disordered eating, managing stress, sexuality, and relationship issues. The Center is open Monday-Friday from 8:30 a.m. to 5 p.m. During the academic year when the undergraduate school is in session (excluding summer), and Student Health Service is open, after-hours psychological crises are handled by calling Student Health Service to reach the on-call counselor.

Grading

Records of progress are kept by the institution on all students enrolled. Grade reports are furnished to students at the end of each semester or summer term.

Grade of I. The grade of I (Incomplete) may be assigned only when a student fails to complete the work of a course because of illness or some other emergency. If the work recorded as I is not completed within thirty days after the student enters for his or her next semester, not counting the summer session, the grade automatically becomes F. The instructor must report the final grade to the registrar within forty-five days after the beginning of that semester. In no case is a graduate degree awarded to a student who has an I or NR on record. Incomplete grade forms are available on the Graduate School website.

Grade of NR. The grade of NR (Not Reported) must be resolved within forty-five days after the beginning of the next semester or the grade automatically becomes F or Unsatisfactory.

Minimum Grade Requirements. A student whose cumulative grade point average (GPA) falls below 2.5 (or below a program/department GPA standard) may be placed on academic probation. The student will have one semester to bring his/her GPA to 2.5 or greater; otherwise, the student may be dismissed from the Graduate School by the dean. The grade point average is obtained by dividing the total number of grade points earned by the total number of hours attempted for a grade, including hours for courses in which the grade is F. Satisfactory/unsatisfactory grades do not enter into the GPA.

Grades Assigned		Grade Points
A	Excellent	4.00
A-		3.67
B+		3.33
B	Good	3.00
B-		2.67
C+		2.33
C	Low Pass	2.00
F	Failed (counted as hours attempted)	
I	Incomplete (becomes passing grade or F)	
P	Pass	
S	Satisfactory	
U	Unsatisfactory	
AUD	Audit	
DRP	Official Drop	
	(not counted as hours attempted)	
NC	No credit	
NR	Grade not reported	
	(becomes passing grade or F)	
RPT	Course repeated (see repeating a course)	
WD	Withdrew	
	(not counted as hours attempted)	
WP	Withdrew passing	
	(not counted as hours attempted)	
WF	Withdrew failing	
	(not counted as hours attempted)	

Individual departments or programs may require a higher grade point average than 2.5 for continuation. If there is such a requirement, it is stated in the departmental or program policies. A student may be dismissed from the Graduate School by the dean upon recommendation of his or her department or program if he or she does not make adequate progress in research. Adequate progress is determined by the standards of the department or program in which the student is enrolled.

The minimum grade point average required for graduation is 3.0. PhD candidates must have a grade point average of 3.0 in graduate courses at the time of the preliminary examination.

Repeating a Course. Beginning with fall 1999 courses, a graduate student may repeat a course in which a B- or lower grade has been received. The course may be counted only one time for credit. The higher grade earned will be counted in calculation of grade point average. Both grades will appear on the transcript.

Dropping a Course. With the approval of the advisor and instructor, a student may drop a course during the first month of a semester or the equivalent period during a summer term without penalty or notation on the transcript.

A student who is permitted to drop a course after the first month, with the approval of the dean of the Graduate School and the department concerned, is assigned a Drop (DRP). Courses marked Drop are not counted in determining the grade point average. Add/Drop forms may be accessed on the Graduate School website.

Auditing a Course. Auditing a course consists of participation in a course without receiving a letter grade or credit hours. When space is available after registration of students enrolled for credit, others may request permission of the instructor to enter the course as auditors. In no case may anyone register to audit a course before the first meeting of the class. No additional charge is made to full-time students in the Graduate School of Arts and Sciences; for others the fee is \$85 per hour. In addition to the permission of the course instructor, permission of the advisor is required for degree-seeking students. An auditor is subject to attendance regulations and to other requirements of performance established by the instructor. Although an auditor receives no credit, a notation of audit is made on the final grade report and entered on the record of enrolled students who have met the instructor's requirements.

Continuous Enrollment. Degree-seeking students must have continuous enrollment through the semester in which they graduate. Enrollment may be achieved by registering for courses, including research, or by registering as Thesis Only or Graduate Fee.

Leave of Absence. Students who wish to take a leave of absence must receive approval from the department concerned and the dean of the Graduate School. The student must submit a leave of absence request in writing, be in good academic

standing, complete forms required by the Graduate School for courses in progress, and provide letters of support from the program director and advisor. The maximum time for a leave of absence is one academic year. Wake Forest University does not have a leave of absence policy that would either exempt any student from the requirements of the Return of Title IV Funds policy, or extend federal student loan deferment benefits.

One month prior to the beginning of the semester in which the student plans to re-enter the Graduate School, a written reinstatement request must be sent to the dean of the Graduate School. The time spent during the leave of absence will not count in the maximum time allotted for the degree. If a student on an approved leave has not requested reinstatement after a year, the student will be considered to have withdrawn from Graduate School.

Transferring to a Different Program. A student who wishes to transfer from one program to another should be allowed to do so provided the standards of the new department or program are met. The student should contact the graduate director of the department or program to which he or she wishes to transfer. After consultation with the graduate director, the student should interview with one or more prospective advisors. If a prospective advisor is identified, the student's transfer request may be considered further.

Upon receipt of a written request from the student, the Graduate School will forward credentials from the student's file to the graduate director for evaluation and consideration of financial aid. At the conclusion of this process, the graduate director sends a transfer recommendation to the dean of the Graduate School for approval. The student is not required to withdraw from an existing program until the transfer request to the new department has been approved.

It is understood that the department or program from which the student is transferring would have no further financial responsibility for the student. The student must, however, complete the formal process of withdrawing from the original program by the end of the current semester.

Withdrawal from the University. Students who wish to withdraw from the Graduate School must complete the appropriate form, which requires approval from the department concerned and the dean of the Graduate School. Students who leave

without following this procedure will receive a grade of F in each course in progress. Students on the Reynolda campus who were issued a Graduate School laptop computer are required to return it to Information Systems. Students on the Bowman Gray campus are required to return their laptop computers to the Graduate School office.

Students who withdraw by the drop date, established by the academic calendar, of the semester will not have a grade recorded for courses in progress. Students who withdraw after the drop deadline will be assigned a grade of withdraw-passing or withdraw-failing for each course in progress.

Students who have withdrawn from the Graduate School and wish to return within one academic year must request reinstatement in writing to the dean of the Graduate School at least one month prior to the semester in which they wish to re-enter.

To be reinstated the student must be in good academic standing and receive approval from the graduate program and the dean of the Graduate School. The time spent during this one year of withdrawal will not count in the maximum time allotted for the degree.

Students who have withdrawn from the Graduate School and who wish to re-enter after one academic year must reapply for admission as stated in the Graduate Bulletin by the application deadline, and must be recommended by the program and accepted by the dean of the Graduate School.

If a student is approved for readmission to the Graduate School within a five-year period, previous coursework may count towards the degree requirements at the discretion of the dean of the Graduate School on the recommendation of the graduate program concerned. If the student re-enters Graduate School after a five-year period, previous courses will not count in the degree requirements.

Policy of External Remuneration

A student supported on a stipend from the graduate school, faculty grant, student fellowship or other sources may be allowed to engage in additional remunerative work with written permission from his or her advisor and as long as it does not delay or interfere with the duties required for timely completion of the degree.

Disposition of Students of Faculty Who Leave the Institution

In the event that a graduate faculty member leaves the institution prior to completion of the degree by his or her student(s), the Dissertation Committee (or Department Graduate Committee if there is no Dissertation Committee) is responsible for recommending an appropriate plan for the completion of the degree. The plan should address the following: support of stipend and research funding (including lab space), designation of a primary mentor, and designation of a manager to carry out the plan. This plan must be submitted within six weeks of the faculty member's resignation and approved by the dean.

Student Rights and Responsibilities

The graduate faculty has adopted a formal statement regarding student rights and responsibilities. The statement is a guideline to be used by students with respect to an honor code which applies to both teaching and research endeavors. It also includes clearly defined procedures for the handling of student grievances should they arise. This statement may be accessed on the Graduate School website.

Honor Code

The graduate faculty has adopted a formal honor code to provide guidance for student conduct with respect to academic pursuits. This policy may be accessed on the Graduate School website.

Patents Policy

Inventions and Patents. During a student's course of study, he or she may participate in research or other work which leads to an invention or discovery. These inventions or discoveries are the property of the University. The University's Inventions and Patent Policy is applicable to student inventions with respect to the definition of inventions covered, resolution of disputes, and the division of proceeds, including the determination of the inventor(s) share of any proceeds. Under this policy, a program exists to determine patentability and commercial value of each invention. Advice and guidance regarding this policy are available from the Office of Technology Asset Management.

Requirements for Degrees

Degrees Offered

The Graduate School of Arts and Sciences offers graduate programs leading to the master of arts, master of arts in education, master of arts in liberal studies, master of fine arts, master of science, and doctor of philosophy degrees. For a description of the programs, see Courses of Instruction in this publication.

Minor Program in Biomedical Sciences

A certified minor, indicated as such on the official transcript, may be obtained in some programs within the biomedical sciences (Bowman Gray campus) by completing 12 semester-hours of coursework, including specific courses as required by individual programs. Program directors should be consulted for details.

Requirements for the Master of Arts

Programs of study leading to the master of arts degree are offered in bioethics, communication, English, mathematics, psychology, and religion. The degree is awarded to candidates who complete a minimum of 24 semester-hours of faculty-approved coursework with an average grade of B or above on all courses attempted, meet any foreign language or special skills requirement, and write an acceptable thesis (if required) for which six hours of credit toward the 30 required for graduation are allotted. Students may earn additional credit for thesis research, but such hours may not be substituted for the 24 hours of coursework required.

Residence Requirements. The minimum residence requirement is one academic year or three summer sessions. In practice, most students in the arts require at least a summer session in addition to the academic year, and most science students require two years. In all cases, work for the degree must be completed within six calendar years of the date of initial enrollment in the Graduate School.

Course Requirements. At least 12 of the 24 hours in coursework (not counting thesis research) required for the degree must be in courses numbered 700 or above. The remaining 12 hours may be in either 600-level, 700-level, or 800-level courses. Credit may be allowed for as many as six hours of graduate work transferred from another institution at the discretion of the program director and dean of the Graduate School, but the minimum residence requirement is not thereby reduced.

Foreign Language or Special Skills Requirement. Some departments may require students to demonstrate a reading knowledge of an appropriate foreign language or competency in a special skill. Refer to each program's statement to see if there is such a requirement and how it may be satisfied.

Admission to Degree Candidacy. A student is admitted to degree candidacy by the dean of the Graduate School after recommendation by the major department. The student must have satisfactorily met any foreign language or special skills requirement and is expected to complete the master's degree requirements with one additional semester's work.

Thesis Requirement. Some of the departments granting a master of arts degree require a thesis; the student should check with the individual department. If required, six of the 30 hours required for the MA degree are allotted for the thesis. Thesis courses are graded S (Satisfactory) or U (Unsatisfactory). If a U is assigned, the course must be repeated and an S earned before the degree can be awarded.

Theses are written under the supervision of the student's advisory committee (an advisor from the department, a second reader from within the department, and a third reader either from outside the department or the student's area of concentration). All members of the advisory committee should be members of the graduate faculty. The committee will be appointed by the dean of the Graduate

School. With the approval of his or her advisor, a student may recommend a person who is not on the graduate faculty to serve on the examining committee as a voting member; however, the committee must have a minimum of two members from the graduate faculty. The thesis advisor must justify the participation of this person on the basis of research, publications, and/or professional activities in a letter to the dean requesting approval.

Final Examination. Requirements for thesis submission and format are posted on the WFU Graduate School website. (<http://graduate.wfu.edu>) The examination covers the thesis and knowledge in related areas. The possible committee decisions are unconditional pass, pass upon rectifying deficiencies, and fail. If a student fails, he/she may be reexamined only once. The defense must take place at least 10 days prior to graduation.

Pass. If all committee members agree that the student has passed unconditionally, there is consensus to pass the examination. The committee chair will sign the ballot, submit the ballot to the Graduate School, and the student shall be recommended for award of the degree.

Pass Upon Rectifying Minor Deficiencies. If reservations are expressed by committee members, the chair of the committee will ensure that the reservations are communicated to the student and the dean of the Graduate School by signing and submitting the ballot to the Graduate School. The student and the advisor are jointly responsible for ensuring that the dissertation is modified to meet the committee's reservations. When the dissertation has been modified, the student passes the examination, and the student will be recommended for award of the degree.

Pass Upon Rectifying Major Deficiencies. If reservations are expressed by committee members, the chair of the committee will ensure that the reservations are communicated to the student and the dean of the Graduate School by signing and submitting the ballot to the Graduate School. The student and the advisor are jointly responsible for ensuring that the dissertation is modified to meet the committee's reservations. When the dissertation has been modified, the student passes the examination, and the student will be recommended for award of the degree.

Fail. If, in the opinion of more than one member of the thesis or dissertation committee, the student has failed the examination, there is no consensus to pass. The chair of the committee will advise the student that the dissertation fails to meet the requirements of the Graduate School. The chair will ensure that the student knows the reason(s) for failure and will submit the ballot to the Graduate School. If the student resubmits or submits a new dissertation for consideration by the Graduate School, at least three members for the dissertation will be drawn from the original committee. If the modified or new dissertation fails to meet the requirements of the Graduate School, the student shall be dismissed.

Requirements for the Master of Arts in Counseling

There are two programs offered through the Department of Counseling, the school counseling program and the clinical mental health counseling program.

The school counseling program. The school counseling program provides prospective school counselors with the knowledge, skills, and competence necessary to establish and conduct effective developmental guidance and counseling programs in schools, kindergarten through the 12th grade. The course of study which leads to a license in school counseling in North Carolina is based on the requirements of the North Carolina Department of Public Instruction and is accredited by the National Council for Accreditation of Teacher Education and by the Council on Accreditation of Counseling and Related Educational Programs (CACREP). School counseling students are not required to hold a teacher's license to enter the program.

The clinical mental health program. In the clinical mental health program, students are prepared for counseling in a wide variety of community settings and agencies. The course of study is accredited by the Council on Accreditation of Counseling and Related Educational Programs (CACREP). Students are admitted on a full-time basis only and all students begin their studies in the fall semester.

Graduates are eligible to sit for the National Certified Counselor examination. Those who complete the school counseling program are eligible to apply for licensure with the public schools of North Carolina.

Residence Requirement. The program takes two years and summer school attendance is required between the first and second years. The maximum number of years to obtain the degree from the time of enrollment is six years.

Admission to Degree Candidacy. A student is admitted to degree candidacy by the dean of the Graduate School after recommendation by the counseling department. The student must expect to complete the master's degree requirements with one additional semester's work.

Course requirements. The master of arts degree in counseling is awarded to candidates who successfully complete a minimum of 60 hours in a planned and directed program of study. The program consists of 13 required core courses, three clinical (field experience) courses, and three courses in one of the two program specialty areas (the school counseling program or the clinical mental health program) plus at least one elective. Credit may be allowed for as many as six hours of graduate work transferred from another institution at the discretion of the program director and dean of the Graduate School but the minimum residence requirement is not thereby reduced.

Continuation. Continuation in the program and admission to candidacy is dependent on academic performance and personal and professional development. In addition to maintaining an average of B or better in academic courses, the counseling department requires students to make a grade of B or better in each prerequisite counseling skills and clinical course in order to enroll in the next course. In the event a student makes a grade of C or lower in one of the courses listed, that course must be repeated. If a second grade of C or lower is made in the same course, the student is recommended for dismissal from the program. The progression of counseling skills and clinical courses is as follows: CNS 737, 738, 739, 744, and 745.

Master of Divinity/Master of Arts in Counseling Dual Degree

This degree is an academic program for graduates who seek to enter the ministry with skills in both theology and in counseling. Students accepted into the dual degree program can complete the requirements for both Divinity and Master of Arts in Counseling degrees in four years instead of the usual five. In this combined program, neither the MDiv nor the MA in Counseling is compromised. The curriculum is in line with the accreditation bodies of both partners. Graduates will meet the educational requirements of licensure as professional counselors in North Carolina and in most other states.

Course Requirements and Structure of the Program.

Students in the dual degree program spend the first two years of the four year program in the School of Divinity. The second two years of the dual degree program are spent satisfying the requirements of the MA in Counseling program.

Divinity Requirements—First Two Years.

The School of Divinity's regular program of study requires 67 hours of core courses and 23 hours of general electives for a total of 90 hours. The program of study for dual degree students includes 54 hours of core courses (with Art II requirement met in counseling internships, multicultural requirements met either in CPE, Vienna, or counseling cultures course) and a minimum of nine hours of electives in the School of Divinity plus successful completion of 27 graduate-hours of electives in the counseling department for a total of 90 hours.

Counseling Requirements—Second Two Years. The Department of Counseling's program of study requires 41 hours of core courses, eight hours of clinical courses, nine hours in a program specialty area and at least three hours of electives for a total of 60 hours. The program of study for dual degree students is the same as those students in the clinical mental health program specialty area.

Admissions. Up to three students per year are admitted to the MDiv/MA counseling dual degree program. Applicants must be accepted for

admission by both the Department of Counseling and by the School of Divinity. Applicants are required to submit applications to both schools by January 15. Applications for the counseling program are submitted through the Graduate School of Arts and Sciences. Applications for the School of Divinity are submitted directly to the School of Divinity. Highly qualified applicants are interviewed separately by the admissions committees of each school. After the interview phase, a joint admissions committee composed of members from both schools will make the final selection. Unsuccessful applicants to the dual degree program have the option of applying to the School of Divinity by May 1 but must wait until January of the following year to apply for admission to the Department of Counseling or reapply to the dual degree program.

Continuation in the program. A joint committee composed of faculty from both schools meet each semester to review the progress of each dual degree student academically and personally. Satisfactory academic progress is a B average or better. Guidelines about behaviors and/or attitudes that would constitute remediation or dismissal from the program are based on those already developed by the Department of Counseling.

Upon successful completion of the counseling program, students receive both the MDiv and the MA in Counseling degrees.

Requirements for the Master of Arts in Documentary Film

The Documentary Film Program (DFP) offers graduate study leading to the MA degree in documentary film through a two-year course of study. The program admits students on a full-time basis only.

The MA requires 36 hours: 30 in required documentary courses such as research, theory, writing, direction, and production; and, 6 hours in creative thesis. All students follow the same course of study for the first two years. The primary members of the thesis committee are the DFP faculty, but a student may include an additional committee member from outside of the program if so desired.

Requirements for the Master of Fine Arts in Documentary Film

The Documentary Film Program offers graduate study leading to the MFA degree in documentary film through a three-year course of study. The program admits students on a full-time basis only.

The MFA requires 54 hours and builds on the foundation of the first two years of study with the following: advanced work in a cognate area, a course in pedagogy and curriculum, an option to take a teaching practicum, and an advanced creative project. The primary members of the project committee are the DFP faculty, but a student may include an additional committee member from outside of the program if so desired.

Requirements for the Master of Arts in Education

Graduate work in the Department of Education is offered leading to the master of arts in education degree. In addition to qualifying for admission to the Graduate School, candidates for the master of arts in education degree seeking a North Carolina Class G Teacher's License must possess a North Carolina Class A Teacher's License or its equivalent. Master Teacher Fellows are not expected to hold a teacher's license when they enter the program.

Residence Requirement. Full-time teacher education students complete the program in one academic year. Students enrolled on a part-time basis may require three years or longer to complete the degree. The master of arts in education degree is awarded to candidates who successfully complete the following requirements within six calendar years of the date of initial enrollment in the Graduate School.

Course Requirements. The Master Teacher Fellows program requires 44 semester hours for English, math, science and social studies areas and 49 semester-hours for French and Spanish. The Master Teacher Associates program requires 39 semester-hours for secondary English, math, science and social studies areas and 42 semester-hours for K-12 French and Spanish. All courses must be approved, and an overall grade-point-average of B must be maintained. The course requirements must be

completed in courses numbered 600 or above, with at least half of the total number of required hours in courses numbered 700 or above.

Research Competence in Teacher Education.

Research competence in Teacher Education includes a set of three courses that include both research studies and personal reflection. Credit may be allowed for as many as six hours of graduate work transferred from another institution at the discretion of the program director and dean of the Graduate School, but the minimum residence requirement is not thereby reduced.

Admission to Degree Candidacy. A student is admitted to degree candidacy by the dean of the Graduate School after recommendation by the education department. The student must expect to complete the master's degree requirements with one additional semester's work.

Requirements for the Master of Arts in Interpreting and Translation Studies

The ITS program offers graduate study leading to a professional MA degree in Interpreting and Translation Studies through an intense two-semester course of study. The program offers three tracks: Interpreting and Translation Studies, Intercultural Services in Healthcare and Teaching of Interpreting. The program admits students on a full-time basis only.

In this intense two-semester program, students in each track are required to complete 30 credit hours of course instruction, 1 credit hour of internship, and a 4 credit hour applied research project. At the end of the second semester of the student's program of study, this project will be presented and defended to the ITS graduate committee. The primary members of the applied research project committee are the ITS program faculty, but a student may include an approved committee member from outside of the program.

Requirements for the Master of Arts in Liberal Studies

The MALS degree is awarded to candidates who complete 27 hours of faculty-approved coursework with an average grade of B or above on all courses

attempted and an acceptable thesis/project for which three hours of credit toward the 30 required for graduation are awarded, or who complete 33 hours of faculty-approved coursework with an average grade of B or above on all courses attempted and submit an acceptable paper which synthesizes their experience in the MALS program.

Residence Requirement. There is no minimum residence requirement. A student may take six years to complete the degree.

Course Requirements. The degree is awarded to candidates who either complete 27 hours of faculty-approved coursework with an average grade of B or above on all courses attempted and an acceptable thesis/project for which three hours of credit toward the 30 required for graduation are awarded, or who complete 33 hours of faculty-approved coursework with an average grade of B or above on all courses attempted and submit an acceptable paper which synthesizes their experience in the MALS program.

For the thesis-option students, a minimum of 12 of the 27 hours of coursework must be chosen from the interdisciplinary courses particularly designed for the liberal studies program; for non-thesis-option students, a minimum of 15 of the 33 hours of coursework must be chosen from the interdisciplinary courses particularly designed for the liberal studies program. A student may take all required courses from these specially designed offerings. The Directed Study Course (MLS 786) as well as MLS 693/694 do not count toward the requirement of four liberal studies courses. A maximum of five courses for thesis-option students, or six courses for non-thesis-option students may be chosen from 600- and 700-level departmental courses that carry three hours of graduate credit. No more than four 600-level courses may count toward the thesis-option degree; no more than five 600-level courses may count toward the non-thesis-option. A student may transfer a maximum of six semester-hours from another liberal studies program or from an appropriate graduate program at the discretion of the director and the dean of the Graduate School.

Admission to Degree Candidacy. A student is admitted to degree candidacy by the dean of the Graduate School after recommendation by the liberal studies program. The student must expect

to complete the master's degree requirements with one additional semester's work.

Thesis Requirement. Three of the 30 hours required for the MALS degree are allotted for the thesis. Thesis courses are graded S (Satisfactory) or U (Unsatisfactory). If a U is assigned, the course must be repeated and an S earned before the degree can be awarded.

Theses are written under the supervision of the student's advisory committee (an advisor, and two other readers). All members of the advisory committee should be members of the graduate faculty. The committee will be appointed by the dean of the Graduate School. With the approval of his or her advisor, a student may recommend a person who is not on the graduate faculty to serve on the examining committee as a voting member; however, the committee must have a minimum of two members from the graduate faculty. The thesis advisor must justify the participation of this person on the basis of research, publications, and/or professional activities in a letter to the dean. The defense must take place at least 10 days prior to graduation.

The liberal studies thesis project may be a traditional research paper, a field research project, or a creative work.

Final Examination. Requirements for thesis submission and format are posted on the WFU Graduate School website. (<http://graduate.wfu.edu>) The examination covers the thesis and knowledge in related areas. The possible committee decisions are unconditional pass, pass upon rectifying deficiencies, and fail. If a student fails, he/she may be reexamined only once.

Pass. If all committee members agree that the student has passed unconditionally, there is consensus to pass the examination. The committee chair will sign the ballot, submit the ballot to the Graduate School, and the student shall be recommended for award of the degree.

Pass Upon Rectifying Minor Deficiencies. If reservations are expressed by committee members, the chair of the committee will ensure that the reservations are communicated to the student and the dean of the Graduate School by signing and submitting the ballot to the Graduate School. The student and the advisor are jointly responsible for

ensuring that the dissertation is modified to meet the committee's reservations. When the dissertation has been modified, the student passes the examination and the student will be recommended for award of the degree.

Pass Upon Rectifying Major Deficiencies. If reservations are expressed by committee members, the chair of the committee will ensure that the reservations are communicated to the student and the dean of the Graduate School by signing and submitting the ballot to the Graduate School. The student and the advisor are jointly responsible for ensuring that the dissertation is modified to meet the committee's reservations. When the dissertation has been modified, the student passes the examination and the student will be recommended for award of the degree.

Fail. If, in the opinion of more than one member of the thesis or dissertation committee, the student has failed the examination, there is no consensus to pass. The chair of the committee will advise the student that the dissertation fails to meet the requirements of the Graduate School. The chair will ensure that the student knows the reason(s) for failure and will submit the ballot to the Graduate School. If the student resubmits or submits a new dissertation for consideration by the Graduate School, at least three members for the dissertation will be drawn from the original committee. If the modified or new dissertation fails to meet the requirements of the Graduate School, the student shall be dismissed.

Requirements for the Master of Science

The master of science degree is offered on the Reynolda campus in biology, chemistry, computer science, health and exercise science, and physics. On the Bowman Gray campus, this degree is offered in biomedical engineering, comparative medicine, clinical and population translational sciences, and molecular medicine and translational science.

Residence Requirement. In general, a minimum of 12 months of full-time work or its equivalent in residence is required for the master's degree. For students who have already completed part of their graduate work, appropriate adjustment of the residence requirement can be made by the Graduate

Council. The total allowable time for completion of the degree must not exceed six years.

Course Requirements. A master of science degree candidate must have a minimum of 30 semester-hours of graduate credit. This minimum requirement can include no more than six hours of research. For the Reynolda Campus, at least 12 of the 24 hours in coursework (not counting thesis research) required for the degree must be in courses numbered 700 or above. The remaining 12 hours may be in either 600-level, 700-level or 800-level courses.

The course of study consisting of classes, seminars, and research is compiled by the student, the student's advisor, and the chair of the department of the major field of interest. It is recommended that, when possible, such programs include courses in fields other than that of major interest. Credit may be allowed for as many as six hours of graduate work transferred from another institution at the discretion of the program director and dean of the Graduate School, but the minimum residence requirement is not thereby reduced.

Foreign Language or Special Skills Requirement. Some departments may require students to demonstrate either a reading knowledge of an appropriate foreign language, or competence in a special skill. See each department's statement to determine if there is such a requirement and how it may be satisfied.

Scientific Integrity and Responsible Conduct in Research. (Bowman Gray campus) The successful completion of a program in scientific ethics is required prior to admission to degree candidacy. This requirement is fulfilled either by participating in the courses designated by the Graduate School or by satisfactory completion of approved departmental electives that incorporate extensive discussion of scientific ethics. A list of approved departmental electives may be obtained from the Graduate School. Masters students in other disciplines have the option of participating in this program.

Admission to Degree Candidacy. A student is admitted to degree candidacy by the dean of the Graduate School after recommendation by the major department. The student must

have met satisfactorily any foreign language, special skills, or ethics requirement and is expected to complete the master's degree requirements by one additional semester's work.

Thesis Requirement. Some of the departments granting a master of science degree require a thesis; the student should check with the individual department. If a thesis is required, six of the 30 hours required for the MS degree are for thesis research. Thesis research courses are graded S (Satisfactory) or U (Unsatisfactory). If a U is assigned, the course must be repeated and an S earned before the degree can be awarded.

Theses are written under the supervision of the student's advisory committee (an advisor from the department, a second reader from within the department, and a third reader either from outside the department or the student's area of concentration). All members of the advisory committee should be members of the graduate faculty. The committee will be appointed by the dean of the Graduate School. With the approval of his or her advisor, a student may recommend a person who is not on the graduate faculty to serve on the examining committee as a voting member; however, the committee must have a minimum of two members from the Graduate Faculty. The thesis advisor must justify the participation of this person on the basis of research, publications, and/or professional activities in a letter to the dean requesting approval.

Final Examination. The examination covers the thesis and knowledge in related areas. Requirements for thesis submission and format are posted on the Graduate School website (<http://graduate.wfu.edu>). The possible committee decisions are unconditional pass, pass upon rectifying deficiencies, and fail. If a student fails, he/she may be reexamined only once. For the biomedical sciences, a final copy of the thesis must be submitted by the candidate to the dean of the Graduate School at least four weeks before the proposed date of the final examination and distributed to the examining committee at least three weeks before the final examination. The committee is polled by the chair of the examining committee at least ten days before the proposed date of the examination to determine the acceptability of the thesis. For the Reynolda Campus, the defense must take place at least 10 days prior to graduation.

Pass. If all committee members agree that the student has passed unconditionally, there is consensus to pass the examination. The committee chair will sign the ballot, submit the ballot to the Graduate School, and the student shall be recommended for award of the degree.

Pass Upon Rectifying Minor Deficiencies. If reservations are expressed by committee members, the chair of the committee will ensure that the reservations are communicated to the student and the dean of the Graduate School by signing and submitting the ballot to the Graduate School. The student and the advisor are jointly responsible for ensuring that the dissertation is modified to meet the committee's reservations. When the dissertation has been modified, the student passes the examination and the student will be recommended for award of the degree.

Pass Upon Rectifying Major Deficiencies. If reservations are expressed by committee members, the chair of the committee will ensure that the reservations are communicated to the student and the dean of the Graduate School by signing and submitting the ballot to the Graduate School. The student and the advisor are jointly responsible for ensuring that the dissertation is modified to meet the committee's reservations. When the dissertation has been modified, the student passes the examination and the student will be recommended for award of the degree.

Fail. If, in the opinion of more than one member of the thesis or dissertation committee, the student has failed the examination, there is no consensus to pass. The chair of the committee will advise the student that the dissertation fails to meet the requirements of the Graduate School. The chair will ensure that the student knows the reason(s) for failure and will submit the ballot to the Graduate School. If the student resubmits or submits a new dissertation for consideration by the Graduate School, at least three members for the dissertation will be drawn from the original committee. If the modified or new dissertation fails to meet the requirements of the Graduate School, the student shall be dismissed.

Requirements for the Doctor of Philosophy

Programs of study leading to the doctor of philosophy degree are offered in biochemistry and molecular biology, biology, biomedical engineering, cancer biology, chemistry, microbiology and immunology, molecular pathology, molecular genetics and genomics, molecular medicine and translational science, neuroscience, physics, and integrative physiology and pharmacology.

Residence Requirement. A minimum of three years of full-time study, of which at least two must be in full-time residence at the University. The total allowable time for completion of the degree must not exceed seven years.

Course Requirements and Advisory Committee. Specific course requirements are not prescribed. Coursework is arranged by the student's advisory committee with the approval of the departmental or program graduate committee to provide mastery of appropriate fields of concentration. The advisory committee is appointed by the chair of the department or the program director and consists of the student's advisor and two other members of the department or program. Teaching experience during the period of study is encouraged.

Foreign Language or Special Skills Requirement. Some departments may require students to demonstrate either a reading knowledge of one or more appropriate foreign languages, or competence in one or more special skills. See each department's statement to see if there is such a requirement and how it may be satisfied.

Scientific Integrity and Responsible Conduct of Research. The successful completion of a program in scientific ethics is required prior to admission to degree candidacy. This requirement is fulfilled either by participating in the courses designated by the Graduate School or by satisfactory completion of approved departmental electives that incorporate extensive discussion of scientific ethics. A list of approved departmental electives may be obtained from the Graduate School.

Professional Development Requirement for Biomedical Sciences (Bowman Gray campus). The successful completion of a program in professional development is required prior to admission

to degree candidacy. This requirement is fulfilled by participating in the course Introduction to Professional Development in the Biomedical Sciences which is taken during the first year.

Preliminary Examination. This examination is conducted by the major department. The examining committee selected by the department includes at least three members, one of whom represents a related concentration area. A single written examination or a series of written examinations should cover all areas of concentration and collateral studies. There may also be an oral examination in which any faculty member invited by the examining committee may participate. The examining committee passes or fails the student. In case of failure, the committee can recommend that the candidate be dropped or that reexamination be allowed no earlier than six months from the date of the first examination. A student may be reexamined only once. The preliminary examination is normally given near the end of the student's second year of graduate study and must be passed at least twelve months prior to the date of the awarding of the degree.

Admission to Degree Candidacy. A student is admitted to degree candidacy by the dean of the Graduate School after recommendation by the chair of the major department or program director. Each candidate must have passed the preliminary examination and must have satisfied any foreign language or special skills requirement.

Dissertation Requirement. Dissertation research courses are graded S (Satisfactory) or U (Unsatisfactory). If a U is assigned, the course must be repeated and an S earned before the degree can be awarded.

Under the supervision of an advisory committee, the candidate prepares a dissertation embodying the results of investigative efforts in the field of concentration.

The examining committee for the dissertation, which is appointed by the dean of the Graduate School, consists of at least the following five members of the graduate faculty: the chair of the major department/program or a faculty member chosen by the chair, the student's advisor, another member of the major department/program, a representative from a related area from within or outside the department/program and a member from outside

the major department (or in the case of programs, outside of the student's area of concentration) who represents the Graduate Council and who serves as chair of the committee. With the approval of his or her advisor, a student may recommend a person who is not on the graduate faculty to serve on the examining committee as a voting member. The dissertation advisor must justify the participation of this person on the basis of research, publications and/or professional activities in a letter to the dean. Other faculty members may attend the final examination and participate in the questioning.

Final Examination. Requirements for dissertation submission and format are posted on the Graduate School website (<http://graduate.wfu.edu>). At the time the dissertation is submitted, an abstract of 350 words or less must be submitted for publication in Dissertation Abstracts International.

Students on the Bowman Gray campus must submit a copy of the dissertation to the dean of the Graduate School at least four weeks prior to the proposed date of the final examination and copies distributed to the examining committee at least three weeks before the final examination. Two weeks prior to the final examination, the candidate must have prepared copies of his or her doctoral program. A distribution list for the programs is available in the appropriate graduate office. The committee is polled by the chair of the examining committee at least ten days before the proposed date of the examination to determine the acceptability of the dissertation. Programs announcing the date of the examination should not be distributed by the candidate until it is determined by the chair of the examining committee that the dissertation is defensible and that the examination will take place as scheduled.

For the Reynolda Campus the examination covering the student's major field of concentration and the dissertation is held no later than ten days before graduation.

For the Bowman Gray Campus the examination covering the student's major field of concentration and the dissertation is held no later than the final day to defend as noted on the academic calendar.

After the examination of the degree candidate, the chair will ask each of the members of the examining committee whether the candidate has passed unconditionally, passed upon rectifying deficiencies, or failed.

Pass. If all committee members agree that the student has passed unconditionally, there is consensus to pass the examination. The committee chair will sign the ballot, submit the ballot to the Graduate School, and the student shall be recommended for award of the degree.

Pass Upon Rectifying Minor Deficiencies. If reservations are expressed by committee members, the chair of the committee will ensure that the reservations are communicated to the student and the dean of the Graduate School by signing and submitting the ballot to the Graduate School. The student and the advisor are jointly responsible for ensuring that the dissertation is modified to meet the committee's reservations. When the dissertation has been modified, the student passes the examination and the student will be recommended for award of the degree.

Pass Upon Rectifying Major Deficiencies. If reservations are expressed by committee members, the chair of the committee will ensure that the reservations are communicated to the student and the dean of the Graduate School by signing and submitting the ballot to the Graduate School. The student and the advisor are jointly responsible for ensuring that the dissertation is modified to meet the committee's reservations. When the dissertation has been modified, the student passes the examination and the student will be recommended for award of the degree.

Fail. If, in the opinion of more than one member of the thesis or dissertation committee, the student has failed the examination, there is no consensus to pass. The chair of the committee will advise the student that the dissertation fails to meet the requirements of the Graduate School. The chair will ensure that the student knows the reason(s) for failure and will submit the ballot to the Graduate School. If the student resubmits or submits a new dissertation for consideration by the Graduate School, at least three members for the dissertation will be drawn from the original committee. If the modified or new dissertation fails to meet the requirements of the Graduate School, the student shall be dismissed.

The MD/PhD Program

An MD/PhD degree offers graduates outstanding opportunities in the new era of biomedical research of the 21st century. The invaluable perspective of an MD/PhD graduate positions the physician scientist as a crucial link in translating scientific research into improving human health and reducing disease. During the past decade, 62 percent of Nobel prizes in medicine and physiology were awarded to MD or MD/PhD researchers.

With the increasing sophistication of research tools, however, MDs without further formal training rarely have the depth of knowledge needed to progress rapidly in research. The increasing pace of re-search, the need for knowledge in specific techniques, and the competition in funding have made it more difficult for MD clinicians to succeed in a research-intensive career. Optimal training is provided by combining an MD with a PhD academic program.

The MD/PhD program, a combined effort between the School of Medicine and the Graduate School of Wake Forest University, is an integrated program where neither the MD nor the PhD degree is compromised. The student gains the full perspective for identification and analysis of problems related to human health while receiving rigorous training in a basic or translational research discipline—training which provides the depth of knowledge of scientific logic and techniques for an effective, exciting, and successful career in medical research.

The program seeks outstanding students who have already shown aptitude and enthusiasm for research.

Structure of the Program

The duration of the program typically is seven years.

During the summer before entry into medical school, beginning in early June, students attend an orientation program to introduce faculty and available research opportunities. An eight-week research rotation is conducted with a selected member of the participating graduate faculty. This research rotation (and subsequent ones, if needed) familiarize students with faculty and their fields of expertise; usually one of these faculty are chosen as the student's graduate (PhD) adviser.

Years One and Two. The first two academic years are spent as a medical student. Phase I (seven months) introduces core biochemical knowledge, including development and structure of the human body (gross, microscopic, embryological, and radiological anatomy) and basic cellular functions (biochemistry, molecular biology and genetics, immunology, introduction to pathology).

Phase II (months 8-20) includes courses in systems pathophysiology (physiology, pharmacology, microbiology and pathology), and a two-month period for a second rotation in a lab of the selected graduate program in the summer after the first year.

Medicine as a profession, clinical decision making, and epidemiology studies are included in both Phases I and II.

During these years, the student usually attends a graduate seminar course. The seminar meets once a week and provides a continuing in-depth introduction to the chosen graduate discipline in addition to social and intellectual contact with other graduate students and faculty.

If possible, the student chooses a graduate adviser by the end of Phase II of the medical curriculum. Otherwise, the summer after Phase II may be used for another laboratory rotation, prior to choosing an adviser.

At the beginning of year three students will remain with their medical school class for three months of clinical experience. These three months are spent learning basic clinical skills on internal medicine rotations. This clinical experience will introduce the students to the practice of medicine and provide basic skills in completing the history experience during the graduate school years in an out-patient clinic. These three months of training will also increase the flexibility for returning to medical school upon completion of the graduate degree. After completion of the three clinical months the students will then join the graduate school with the new cohort of graduate students.

Years Three through Five. During graduate school years the students will participate in a monthly outpatient clinical experience. Students rotate at a clinic for the underserved working with faculty and private practice physicians. Participation in this clinic not only helps to maintain clinical skills but gives the student experience with balancing research and clinical responsibilities.

The third year is spent taking advanced basic science courses and conducting research. Didactic coursework is intended to supplement the biomedical knowledge base built in the medical school curriculum. Program or departmental courses also provide a more discipline-specific focus and, therefore, depend on the chosen graduate program.

The duration of the dissertation research may vary but typically is completed in years three-to-five and, if needed, a portion of year six. The PhD dissertation is completed and defended prior to returning to clinical studies.

Years Six and Seven. The student completes eighteen months of required clinical rotations (Phase III of the clinical curriculum) which include internal medicine, surgery, pediatrics, obstetrics, women's health, neurology, psychiatry, radiology, anesthesiology, family and community medicine, and emergency medicine. Four months of elective time are spent in other clinical experiences or may be used for completion of graduate studies prior to returning to the medical curriculum. This part of the schedule is tailored to the individual student with the approval of the graduate adviser, MD/PhD program director, and the associate deans for medical education and student services.

Conferring of Degrees. The PhD degree is conferred in the semester in which all requirements for that degree are met. The MD degree shall be awarded upon completion of the program.

Graduate Programs

The graduate programs participating in the MD/PhD program are:

Track 1 - Physics

Track 2 - Chemistry

Track 3 - Biology

Track 4 - Molecular and Cellular Biosciences:

Biochemistry and Molecular Biology

Cancer Biology

Microbiology and Immunology

Molecular Pathology

Molecular Medicine and Translational Science

Molecular Genetics and Genomics

Track 5 - Integrated Physiology and Pharmacology

Track 6 - Neuroscience

Track 7 - Biomedical Engineering

Mechanism of Application

Both the School of Medicine and the Graduate School evaluate the applicant's credentials. The MCAT is the required standardized test for all applicants.

Initial application is through the American Medical College Application Service (AMCAS). When the School of Medicine receives AMCAS applications, students are sent supplemental forms for application to the School of Medicine. The applicant should indicate interest in the combined MD/PhD program on the supplemental application. The School of Medicine supplemental packet requests an evaluation by the applicant's premedical advisory committee. For the MD/PhD program, the applicant should also include letters of evaluation specifically addressing his or her research experience and abilities.

This is a highly competitive, limited program. The two or three students per year who matriculate compete for scholarships that cover tuition throughout the program. In addition to outstanding grades and MCAT scores, the applicant should provide evidence of enthusiasm and aptitude for research, with prior research experience beyond that of college courses. This is an important factor in evaluation of the application.

After the supplemental application packet, MCAT scores, and letter(s) of evaluation are received, the completed application is reviewed by the committees on admissions of the MD/PhD program. Students applying for the MD/PhD program are not considered for admission to MD-only program. A small percentage of applicants are then asked to visit the University for interviews from October through March.

The PhD/MBA Program

In addition to intensive doctoral training, the PhD/MBA program incorporates core knowledge of business and managerial skills to provide the student with a marketable, competitive advantage, whether the student finds employment in industry or academia. Graduates choosing to pursue a traditional tenure-track faculty position will have the managerial and business training to initiate and operate their own research laboratories and to collaborate more effectively with the private sector. Graduates choosing a non-traditional career path will be prepared

to exercise their research training in management positions in the pharmaceutical industry, private foundations, government agencies, or university research and technology transfer offices.

Structure of the Program

The program is a synthesis of curricula from the Graduate School and the Evening MBA Program of the Babcock School, with specialized coursework and opportunities for industrial and business internships. The joint program is open to all PhD-granting departments or programs across all Wake Forest campuses. It has taken students approximately 5 years to complete the joint program, depending on the nature of the graduate research undertaken in the home program. The first year of the curriculum provides students with a core base of knowledge in biomedical sciences and includes training in the core competencies of the home graduate program. At the same time students begin to be exposed to issues related to research and design, career development, and journal clubs. Laboratory rotations usually occur in this first year in accord with Track requirements. The students typically begin their dissertation research during the second year. At the end of the second year and before beginning MBA course-work, the student must take and pass a qualifying exam that will admit him or her to candidacy for the PhD.

A student enrolling in the PhD/MBA program will have 5-6 semesters of evening MBA courses added to his or her graduate degree requirements. Opportunities for industrial projects and internships are possible after ascent to PhD candidacy and during the MBA coursework phase. The PhD and MBA degrees are awarded simultaneously at the completion of all requirements for both degrees.

Application Process

Admissions are administered through the Graduate School of Arts and Sciences. Students wishing to enroll in the program must apply to both programs and meet the respective admissions requirements of the Graduate School of Arts and Sciences and the Babcock Graduate School of Management. Admission to the MBA portion of the program can occur separately after gaining admission to the home graduate program and after securing appropriate release from the home program for

participation in the joint program (this is in the form of a letter from the thesis advisor co-signed by the program director). In addition to the application a copy of the letter should be submitted to Dr. Dwayne Godwin, Associate Dean, Graduate School of Arts and Sciences and Director, PhD/MBA program, c/o Tina M. Payne, Graduate School of Arts and Sciences. The Graduate Record Exam is accepted for admission to the joint program. Prospective students should also submit a one-page statement of interest indicating future plans for use of the joint degree, official transcripts from each college or university attended, and three completed recommendation forms.

Before admission to the program, the applicants complete a personal interview with the PhD/MBA program director and the Wake Forest University Schools of Business. After the interview phase, the top applicants may be offered admission to the joint program.

Bioethics Dual Degree Requirements

Requirements for the Juris Doctor/Master of Arts in Bioethics

Under the joint auspices of the Wake Forest University School of Law and the Graduate School of Arts and Sciences, the JD/MA in Bioethics facilitates an interdisciplinary and comparative study of law and bioethics and encourages students whose academic or career interests require gaining competence in both disciplines. By allowing some law courses to count as electives toward the MA degree, as well as by allowing some graduate bioethics courses to count among the elective credits permitted within the JD curriculum, students are able to earn the dual degree in less time than it would take to earn the two degrees separately. The student in the MA/JD divides his/her time between the School of Law and the Bioethics Program and benefits not only from an array of course offerings from both curricula, but also from the social and general intellectual life of both academic programs.

Students may receive the dual degree in as little as seven semesters, usually registering with the School of Law for six semesters and with the Graduate School for at least one semester. The joint degree grants 12 hours of law credit for bioethics coursework and 6 hours of bioethics credit for law coursework. Typically, students spend their

first year full-time in the law school, complete 12 bioethics hours during their 2nd and 3rd years of law school, and enroll for one semester full-time in the Bioethics program to complete an additional 6 hours of bioethics coursework and the thesis.

Admission to the dual MA/JD program is a two-tiered process. Students interested in the program must first apply separately to the School of Law and the Graduate School of Arts and Sciences and be accepted for admission by both schools. These applications do not need to be simultaneous, but they should indicate their intent to be considered for the dual degree program on their respective applications to the School of Law and the Graduate School. Alternatively, students may submit a separate application to enroll in the dual degree program if already admitted to either School. In order to be considered eligible for admission, the MA/JD candidate must take the Law School Admission Test (LSAT). The Graduate Record Examination (GRE) test is optional, however, and is waived on request. Final decision about admission to the program is made by a joint committee of the MA/JD program. Students should consult the prospectuses of both schools for information about tuition and financial assistance.

To continue in the program, students must remain in good academic standing in both the School of Law and the Graduate School of Arts & Sciences.

Requirements for the Doctor of Medicine/ Master of Arts in Bioethics

Under the joint auspices of the Wake Forest University School of Medicine and the Graduate School of Arts and Sciences, the MD/MA in Bioethics facilitates an interdisciplinary and comparative study of bioethics and medicine and encourages students whose academic or career interests require gaining competence in both disciplines. By allowing some graduate bioethics courses to count among the elective credits permitted within the MD curriculum, students are able to earn the dual degree in less time than it would take to earn the two degrees separately. By dividing their time between the School of Medicine and the Bioethics Program, students benefit not only from an array of course offerings from both curricula, but also from the social and general intellectual life of both academic programs.

The joint degree program grants 8 fourth-year medical school credits for doing a research thesis

relating to bioethics coursework, which also counts 6 hours of bioethics credit toward the MA degree. Students accepted to the program spend four full years in medical school and two full semesters in the Bioethics program, for a total of 5 years. Typically, the Bioethics semesters come after the third year of medical school and the Bioethics thesis is completed during the 4th year of medical school (5th year of the overall program), during two non-clinical elective rotations.

Students usually apply to the MD/MA in Bioethics program during their 3rd year in the School of Medicine. Applicants must follow the general application procedures of the Graduate School of Arts & Sciences. The submission of test scores from the Graduate Record Examination (GRE), however, are waived on submission of valid scores from the Medical College Admission Test (MCAT). Final decision about admission to the program is made by a joint committee of the MD/MA program. Students should consult the prospectuses of both schools for information about tuition and financial assistance.

To continue in the program, students must remain in good academic standing under the minimum standards of both the School of Medicine and the Graduate School of Arts & Sciences.

Requirements for the Master of Divinity/ Master of Arts in Bioethics

Sponsored by the Wake Forest University School of Divinity and the Graduate School of Arts & Sciences, the MDiv/MA in Bioethics facilitates an interdisciplinary conversation between theology and bioethics and provides resources for students whose vocational aims require knowledge and/or competence in both disciplines.

The MDiv/MA can be completed in as little as seven semesters. A student typically completes two and one-half years of work (five semesters, approximately 75 credit hours) primarily in the School of Divinity. The final two semesters are completed in the Bioethics Program but with some electives taken in the School of Divinity. Shared courses are dual-degree appropriate, selected from a list of courses agreed upon by the School of Divinity and the Bioethics Program.

Students complete a total of 102 credit hours in order to earn the dual degree:

- 62 core credit requirements from the MDiv program (omitting 3 credits of Art of Ministry III to be replaced by the MA in Bioethics 6-credit thesis requirement);
- 18 core credit requirements in Bioethics, including the 6-credit hour thesis.
- 6 Divinity credit hours from the following:
 - o CDS 501: Religious Traditions, Spiritual Practices, Beliefs and Healthcare Professions
 - o CDS 601: Spirituality, Religion, and Clinical Medical Ethics
 - o MIN 635a, b: Multicultural CPE
 - o Any Pastoral Care elective
 - o Any Theology elective
- 3 Divinity ethics elective credit hours
- 8 Bioethics elective credit hours
- 5 additional elective credit hours to be chosen by the student from either program.

Admission to the joint degree program is a two-tiered process. Interested students must apply separately to the School of Divinity and the Graduate School of Arts and Sciences and be accepted for admission by both schools. These applications do not need to be simultaneous, but students should indicate on each application their desire to be considered for the joint degree program. Applications are reviewed separately by each program's admissions committee. Alternatively, students may submit a separate application to enroll in the joint degree program if already admitted to either School. Typically, students make application to the dual degree program by the time they complete one semester in either School. A joint admissions committee composed of members from both schools make final admissions decisions. The joint committee also oversees and reviews admissions policies for the dual degree. The Graduate Record Exam (GRE) is typically required for application to the Bioethics Program, but can be waived under certain circumstances which are outlined on the bioethics program website. The School of Divinity recommends, but does not require, GRE scores.

Students are required to follow the student handbook of the school through which he/she is enrolled. To continue in the program, a student must remain in good academic standing with both the School of Divinity and the Graduate School of Arts and Sciences.

Certificate in Bioethics

The Graduate Certificate in Bioethics provides students with basic knowledge and skills that enable them to better address bioethics issues that arise in biomedical research, clinical practice, and health policy. The Graduate Certificate is a freestanding program of graduate study in which students attend the same classes as students in the Master of Arts in Bioethics graduate program.

Structure of the Program

The Graduate Certificate requires 12 credit hours of course work with an average grade of B or above. At least 9 credit hours must come from required courses in the MA in Bioethics program. There is no thesis requirement. All work must be completed within four years of the date of initial enrollment in the graduate program. Up to 3 hours of transfer credit may be considered in place of elective course work. Transfer credit acceptance is based on review and approval of grades, course syllabi, and other relevant information.

Admitted students may enroll in the general Graduate Certificate program or may specialize by enrolling in the Graduate Certificate in Clinical Bioethics or the Graduate Certificate in Biomedical Research Ethics. The specialized certificate options require particular courses within the general requirements described above. The Graduate Certificate in Clinical Bioethics requires students to enroll in BIE 705: Clinical Ethics for 3 of the 9 credit hours of required courses. The Graduate Certificate in Biomedical Research Ethics requires students to enroll in BIE 702: Biomedical Research Ethics for 3 of the 9 credit hours of required courses. Students in the specialized certificate programs may utilize elective courses designed to provide supervised observational and experiential opportunities in relevant settings.

Application Process

Applications will be made to the Graduate School of Arts and Sciences in accordance with the admission procedures described in the Bulletin and the on-line application materials. The GRE is not required; however, GRE results and other test results for higher education, if available, will be considered in determining the applicant's ability to succeed in the program.

Requirements for Certificates in Interpreting and Translation Studies

The ITS program also offers Certificates in the following tracks: Graduate Certificate in Interpreting Studies, Graduate Certificate in Translation Studies, Graduate Certificate in Audiovisual Translation and Interpreting, and Graduate Certificate in Intercultural Services in Healthcare. For students holding an MA, MS, or MBA degree, a Postgraduate Certificate in Teaching Interpreting is available.

Students are required to complete 15 credit hours of instruction within two academic years. A student who chooses to complete three certificates can meet the requirements for an MA in Interpreting and Translation Studies.

Certificate in Medieval Studies for English and Religion MA Students

Cross-disciplinary Coursework and Training

Students are required to take a minimum of four additional courses (12 hours) with a medieval focus; these courses should represent two different disciplinary fields in addition to that of the candidate's home department. In consultation with the program director, one or more of these additional courses may be taken as directed reading or as medieval language courses.

Admission to the program is by permission director or advisory committee. Students must complete all graduate requirements for the MA (in English or religion) and may take undergraduate courses in any participating department towards the certificate. (Courses fulfilling the medieval studies minor are listed in the *Undergraduate Bulletin*.) Courses may overlap with departmental graduate requirements but acquiring a certificate requires coursework beyond that of the disciplinary MA.

Interdisciplinary Thesis Requirements

The graduate thesis must have a medieval focus to be determined in consultation with the program directors. The thesis committee should have at least two participating departments represented. The program generally does not require more time to complete than the host MA program in English or religion. While students working towards the certificate are required to take four courses in medieval studies beyond the standard

requirements of the departmental MA, some of those additional courses may be taken as an overload during the academic years or during the summer. Students are strongly encouraged to apply for extramural fellowships to study one or more summers at the international sites where a medieval studies curriculum is available (e.g., St Peter's College at Oxford) A final mechanism is to request approval from the relevant departmental graduate committee to apply two of the courses taken toward completion for the MA degree toward the certificate program with the addition of relevant course-related materials.

Interdisciplinary Activities

Students are expected to participate in the lectures, readings and, workshops sponsored by medieval studies. For more activities and opportunities available to students in this program, see the Interdisciplinary Graduate Certificate Program in Medieval Studies section of this publication.

Certificate in Science Management Program

The Certificate in Science Management is a unique program that allows graduate students, postdoctoral fellows and interested faculty to access business courses through the Wake Forest University Schools of Business. The certificate is granted after completing 15 hours of coursework. The certificate can stand alone, or the hours taken through the Schools of Business can be transferred to a formal Wake Forest University MBA course of study.

Structure of the Program

The certificate allows flexibility for the student to pursue his/her unique career plan. The student will meet with career counselors in Schools of Business, as well as his/her advisor and graduate program director in order to formulate a plan based on the student's desired career path. Students enrolled in a graduate program will develop a course plan for the pacing of specific courses to coordinate with their thesis research within the home program.

The certificate curriculum is based on existing courses available through the Wake Forest University Schools of Business and the Graduate School of Arts and Sciences. The certificate curriculum contains specific core requirements (MGT 8110.

Organizational Behavior and MGT 8080. Financial Accounting), as well as electives chosen to provide skill sets that are most relevant to their chosen industry career sector. Electives may be chosen from MBA and other graduate-level courses.

Application Process

Graduate students must be in good academic standing. Graduate students (Masters or PhD) must obtain the written permission from their advisor and the student's graduate program director. Postdoctoral fellows must obtain the written permission of their advisor. All students admitted must fulfill academic standards of the home program in the Graduate School of Arts and Sciences, as well as those of the Wake Forest University Schools of Business.

Letter(s) of support should be submitted by the student's thesis advisor or postdoctoral mentor. In the case of postdoctoral fellows only the mentor must submit a letter. In the case of graduate students a single letter can be co-signed by the student's thesis advisor and graduate program director, or separate letters from each will be accepted. In addition to the application a copy of the letter should be submitted to Dr. Dwayne Godwin, Associate Dean, Graduate School of Arts and Sciences and Director, PhD/MBA program, c/o Tina M. Payne, Graduate School of Arts and Sciences.

PhD Graduate students are eligible for the program after passing their qualifying exam and ascending to PhD candidacy. Business courses will be delivered through the working professional or full time programs to fulfill their certificate requirements over 2-3 years of candidacy, during which time they would be completing thesis research (similar to the PhD/MBA model). For current graduate students, up to 6 hours of the certificate may be completed after the Graduate degree is completed. Postdoctoral Fellows would be eligible for the program as soon as their appointment begins. Students and Postdoctoral fellows whose support is derived from NIH grants are responsible for following NIH policies regarding research effort, and should resolve any potential conflicts with their program officer.

Certificate hours obtained through the Wake Forest University Schools of Business will be transferable to the Working Professional program.

Applicants whose native language is not English and/or whose principal language of university instruction was not English must submit scores from either the TOEFL (Test of English as a Foreign Language) or PTE (Pearson Test of English). (Exception: applicants who have completed their undergraduate work at an English-speaking college or university are not required to take the TOEFL or PTE.)

Questions about admissions to either the PhD/ MBA program or the Certificate in Science Management Program should contact Kevin Bender (benderkc@wfu.edu). General questions about the program should be referred to Associate Dean Dr. Dwayne Godwin (dgodwin@wakehealth.edu).

Certificate in Structural and Computational Biophysics

Cross-disciplinary Coursework and Training

At least 15 hours of graduate course work (including a general, introductory SCB course and two hours of journal club credit) are required in the SCB Track. At least one course must be at the 700 level. Students must take at least two graduate hours in each of the curriculum areas: chemistry/biochemistry, computer science, and biophysics. The 15 hours may simultaneously satisfy elective requirements in each discipline.

Interdisciplinary Thesis Requirements

All students in the SCB Track are required to complete and defend a PhD dissertation or MS thesis that involves original, interdisciplinary research in the area of structural and computational biology or biophysics, broadly defined. The student will select a thesis advisor from the SCB faculty. The student and thesis advisor will select a research committee consisting of members from at least three of the participating SCB departments, including the advisor. (This committee is intended to be congruent with existing department research committees, with addition of interdisciplinary members. For doctoral candidates, this can be done within the first two years of admission to the graduate school, concurrent with the individual department requirements.)

Research Topics

Each student must take the one-credit course, SCB 710, offered each fall.

Journal Club

Each student is required to successfully complete the Structural and Computational Biophysics Journal Club twice.

Ethics Training

All students are required to successfully complete a course in scientific ethics. This requirement may be fulfilled by participating in the Scientific Integrity and Responsible Conduct of Research program offered by the Graduate School or completion of one of several approved departmental electives which incorporate extensive discussion of scientific ethics.

SCB Seminars

Occasionally, seminars in the participating departments will be designated as SCB-related seminars. Attendance at SCB-designated seminar is expected.



Courses of Instruction

Semester hours of credit are shown by numerals immediately after the course title—for example, (3) or (3, 3). Some laboratory courses have numerals after the course descriptions showing hours of recitation and laboratory per week—for example, (2-4). The symbols P— and C— followed by course numbers or titles are used to show prerequisites and corequisites in the department. POI indicates permission of instructor is required. Many entries show the name of the professor who teaches the course. Because graduate study occurs at a level of complexity and specialization exceeding that of undergraduate education, the work required of graduate students in any course in which instruction is combined with undergraduate students will reflect this difference.

Biochemistry and Molecular Biology (BICM)

Bowman Gray Campus

Biochemistry

Chair Douglas S. Lyles

Professors Donald W. Bowden, H. Alexander Claiborne, Larry W. Daniel, Jacque Fetrow, Mark O. Lively, Douglas S. Lyles, Linda C. McPhail, Charles S. Morrow, John Parks, Fred W. Perrino, Leslie Poole, Lawrence L. Rudel, Peter B. Smith, Michael J. Thomas, Suzy V. Torti, Alan J. Townsend, Mark Welker

Associate Professors Roy R. Hantgan, Thomas Hollis, Todd Lowther, Yuh-Hwa Wang

Assistant Professors Nicholette Allred, Peter Antinozzi, Cristina Furdul, David Horita, John Wilkinson

Research Assistant Professor Derek Parsonage

Instructors Herman Odens Fuentes, Kimberly Nelson, Susan Sergeant

The graduate training program in biochemistry and molecular biology of the Department of Biochemistry is designed to prepare students for careers of investigation and teaching in biochemistry, molecular biology, and in related sciences that involve biochemical, structural and molecular approaches and techniques. Although the programs of study are individually planned, all students are expected to possess competence in certain basic areas of biochemistry and related sciences. Programs leading to the PhD degree in biochemistry and molecular biology are offered.

Students enter the program through the Molecular and Cellular Biosciences Track and participate in the MCB common curriculum in the first year. Curriculum in subsequent years includes participation in Scientific Communication, Topics in Biochemical Literature and electives of the student's choice. The student also participates in the department's program of research seminars.

Thesis research under the supervision of a faculty member may be pursued in various areas of biochemistry, including enzymology, NMR and X-ray structure determination of macromolecules, virus

assembly, relation of lipid and protein metabolism and of protein-lipid association to membrane structure and function, biological oxidations and bioenergetics, molecular genetics and nucleic acid function, biophysics, biochemical pharmacology of anticancer agents, leukocyte metabolism and function, signal transduction mechanisms in normal and cancerous cells, and molecular mechanisms of blood coagulation. The department has specialized equipment and facilities to support training and investigation in these areas.

The biochemistry program participates in the Interdisciplinary Graduate Track in Structural and Computational Biophysics. For more information, refer to the pages in this bulletin regarding the program.

The graduate program was begun in 1941, and the PhD degree has been offered since 1962.

The following electives are offered through the MCB Track:

MCB 711. Biological Systems and Structures. (2) In depth study of macromolecular assembly and interactions, as well as the application of structural biology and proteomics technology. Contemporary concepts of the principles of protein and nucleic acid structure. Other topics include methods for structure determination such as X-ray diffraction, NMR spectrometry, and molecular modeling.

MCB 712. Biological Spectroscopy. (2) Principles and practicalities of the study of biomolecules using spectroscopic techniques such as absorbance, fluorescence and circular dichroism analyses. Other biophysical approaches such as mass spectrometry and sedimentation analysis will be included. Topics in the study of enzymes utilizing these techniques will be discussed.

MCB 713. Large Experimental Datasets and Analysis. (2) Conducted as a combination of lectures, reading assignments, and student-led discussions. Lectures detail experimental methods that generate large-scale datasets. Topics include genotyping, expression profiling, metabolomics, high-content cellular imaging techniques and practical examples of bioinformatic software and statistic analyses.

MCB 714. Experimental Approaches to Cell Biology and Disease. (2) Conducted as a combination of lectures, reading assignments, and student-led discussions. With an emphasis on cellular functions involved in disease, lectures detail common techniques used in cell biology experimentation. Practical examples and issues of functional genomic approaches are discussed, including design of appropriate cell biology models.

The following advanced courses in BICM are offered:

700, 701. Scientific Communication. (1, 1) Instruction and practice in oral and written scientific communication. Meets weekly.

704. Preparatory Biochemistry. (3) Conducted as a combination of lectures, case studies, reading assignments, course notes, and group conferences. The sequence of topics is: a. protein structure, b. enzyme mechanisms, c. bioenergetics, d. signal transduction, e. intermediary metabolism and f. interorgan metabolism. The principles of each topic are discussed in relation to clinical disease entities, e.g. protein structure: hemoglobin/sickle cell anemia/sickle cell hemoglobin/sickle cell disease due to abnormal hemoglobin structure.

706. Intracellular Signaling. (3) Advanced study of the biochemical mechanisms involved in intracellular signaling of normal and malignant cells, including 1) growth factor and G protein-coupled receptors 2) second messengers, 3) protein kinase cascades, 4) gene regulation, and 5) oncogenes. Lectures and discussions provide in-depth coverage of each topic with emphasis on recent advances and current literature.

709, 710. Special Topics in Biochemical Literature. (2) Critical reading and interpretation of the recent literature in biochemistry. Emphasis is decided by students and staff. Meets weekly. Required of second and third year graduate students in the biochemistry and molecular biology program.

711. Advanced Topics in Protein Structure Determination. (2) Emphasizes methods for modern structure determination using X-ray crystallographic methods. Students are exposed to practical techniques in growth of protein crystals, collection and processing of X-ray diffraction data, phase determination, model building and refinement. Students are also expected to develop an in-depth understanding of the latest instrumentation and programs used in protein structure determination.

714. Instrumental Techniques. (3) Theoretical and technical aspects of instrumentation currently employed in the biological sciences. Experience is provided on a variety of instruments including high performance liquid chromatographs; gas chromatographs; gas chromatograph/mass spectrometer; nuclear magnetic resonance spectrometer; electron paramagnetic resonance spectrometer; ultraviolet, visible, and infrared spectrophotometers; spectrofluorimeters; and cell sorter/cytofluorograph. It is highly recommended but not required that the student have a foundation in electronics equivalent to Physiology 791. P—Chemistry through physical chemistry and two semesters of physics or POI. Offered in odd-numbered years.

715, 716. Special Topics in Biochemistry. (1-9) Advanced conference course that considers various areas of current interest or rapid development. Topics are developed depending on the interests of students and staff.

717, 718. Principles and Practice of Teaching Biochemistry. (2) Structured participation of students as mentors in existing biochemistry classes. Under the supervision of biochemistry faculty, students create laboratory demonstrations, field questions, write and grade exam questions, conduct review sessions and participate in one-on-one instruction.

719, 720. Research. The department offers opportunities for investigation in a wide variety of biochemical subjects under the guidance of staff members.

734. Human Molecular Genetics. (2) Combined lecture/seminar course providing an overview of current theoretical and technical approaches for locating, identifying, and cloning human genes using molecular genetic methods. Emphasis is on the search for genes that contribute to simple single-gene disorders and common complex diseases. Topics include genetic mapping in humans, construction of physical maps of chromosomes, identification of coding sequences and disease susceptibility genes, and functional analysis of gene products.

740. Drug Discovery, Design, and Development—Molecules to Medicines. (3) Conducted as a combination of lectures, reading assignments, and student-led discussions. Examines drug discovery and development pathways from target and lead compound identification through metabolic and toxicology studies, clinical trials, FDA approval, and marketing. Regulatory processes, intellectual property, and ethical issues are also considered. Taught by WFU faculty from both the Reynolda and Bowman Gray campuses and colleagues in the pharmaceutical and biotechnology industries, students work in teams to present case studies on the discovery, development, and marketing of recently approved pharmaceuticals. Also listed as CHM 740. P—Organic chemistry and biochemistry.

745. Drug Discovery Virtual Laboratory. (1) Interactive laboratory course complements Seminars in Drug Discovery, Design, and Development—Molecules to Medicines by providing students with hands-on experience with state-of-the-art software used by the pharmaceutical industry to discover new drugs and refine their target interactions *in silico*. Following an introduction to structure-based drug design principles, students will complete tutorials; guided by WFU faculty from both the Reynolda and Bowman

Gray campuses, they will develop and present exercises that examine how structure-based drug design has contributed to recently approved pharmaceuticals. C—BICM 740.

Bioethics (BIE)

Bowman Gray and Reynolda Campuses

Co-Director, Center for Bioethics, Health & Society; Co-Director, Master of Arts in Bioethics;
Professor, Social Sciences & Health Policy Nancy M. P. King

Co-Director, Master of Arts in Bioethics; Fred D. and Elizabeth L. Turnage Professor of Law;
Professor, Social Sciences & Health Policy Mark A. Hall

Director, Center for Bioethics, Health & Society; Associate Professor, Philosophy Ana Smith Iltis
Director, Legal Analysis, Research & Writing; Professor, Legal Writing Christine Nero Coughlin
Lecturer, Philosophy Hannah Hardgrave

University Distinguished Professor of Communication Ethics; Professor, Communication
Michael J. Hyde

Assistant Professor of Christian Ethics, School of Divinity Kevin Jung

Wallace and Mona Wu Professor of Biomedical Ethics; Professor, General Internal Medicine
John C. Moskop

Professor, Social Sciences and Health Policy Sally A. Shumaker

Adjunct Faculty

Professor, Philosophy, UNC-Greensboro, Terrance McConnell

Director, Medical Humanities; Thatcher Professor of Philosophy, Davidson College,
Lance Stell

Director, Center for Professional and Applied Ethics; Distinguished Professor of Health Care
Ethics, UNC-Charlotte, Rosemarie Tong

The Master of Arts in Bioethics provides an educational opportunity at the graduate level for current and future professionals and others throughout the country interested in bioethics, including health care providers, researchers in biomedicine and the life sciences, lawyers, and professionals in religion, health and research administration, and the biotechnology industry. The goal of the Master of Arts in Bioethics is to equip graduates to practice and teach about bioethics as integral to the work of medicine and biotechnology, health care, and the basic sciences, and to undertake exemplary bioethics-related research and scholarship.

The program has two characteristic emphases: bioethics in social context, and bioethics and biotechnology. First, a general emphasis on the social, cultural, and policy contexts that shape all bioethics questions and issues is visible throughout the curriculum. Although the importance of incorporating the humanities, the social sciences, and even the arts may seem obvious, this is not a component of most bioethics education elsewhere. Second, a focus on bioethics and biotechnology takes advantage of Wake Forest University's strong and growing presence in this area. Research in nanomedicine, genomics, pharmacogenetics, molecular and cell therapies, and the like is ongoing not only here at Wake Forest University but elsewhere in North Carolina.

The program has particular emphases without declaring particular specializations. This is in part because bioethics education is by its nature fundamentally generalist: Students receive broad exposure to ideas, discussion, scholarly literature, and experience, as well as a set of intellectual skills to be developed

and practiced widely before being turned to special areas of interest. Visit www.wfu.edu/bioethics for more information.

Applications are made to the Wake Forest University Graduate School of Arts and Sciences in accordance with the admission procedures described in the Graduate School Bulletin and the online application materials. (<http://graduate.wfu.edu>) All applicants should have received a baccalaureate degree. Applicants should submit a current curriculum vitae or resume. The Statement of Interest should be approximately 300-600 words describing how you expect the Master of Arts in Bioethics will relate to your current and/or future work and interests. The GRE requirement of the Graduate School may be waived upon demonstration of significant relevant professional experience (including advanced degrees), letters of recommendation, and statement of interest in the degree program.

The Master of Arts in Bioethics requires 30 credit hours of work; 24 hours of coursework with an average grade of B or above plus 6 hours of thesis research. At least 12 of the 24 hours of coursework must be in courses numbered 700 or above (graduate students only). The remaining 12 hours may be in either 600 or 700 level courses. All work must be completed within six years of the date of initial enrollment in the graduate program.

Joint degrees facilitate an interdisciplinary and comparative study of bioethics alongside another discipline and so prepare students whose academic or career interests include both. The MD/MA in Bioethics, in conjunction with the Wake Forest University School of Medicine, prepares students to engage bioethical issues in clinical practice and research and can be completed in as little as 5 years. MD/MA students typically complete their MA in Bioethics coursework after their 3rd year of medical school and their MA thesis during their final year of medical school. The JD/MA in Bioethics, in partnership with the Wake Forest University School of Law, prepares students for work in health law and policy and can be completed in as little as 3.5 years. JD/MA students generally take 12 hours of bioethics coursework while enrolled in the law school and then enroll with the Bioethics program for an additional 6 hours of coursework and the thesis. The MDiv/MA in Bioethics, in conjunction with the Wake Forest University School of Divinity, enriches the backgrounds of students who want to pursue careers related to bioethics or ministry and can be completed in as little as 3.5 years. MDiv/MA students typically dedicate their first year to work in the School of Divinity and then take courses in both areas through the remainder of the dual degree program.

The Graduate Certificate in Bioethics provides basic knowledge and skills to enhance health-related employment. The certificate requires 12 credit hours of coursework, including at least 9 hours of required courses. In addition to the general certificate program, students may specialize their work by enrolling in the Graduate Certificate in Clinical Bioethics or the Graduate Certificate in Biomedical Research Ethics, both of which have the same overall credit hour requirements as the general program. The Graduate Certificate in Clinical Bioethics requires that students earn 3 of the 9 hours of required courses in BIE 705: Clinical Bioethics. The Graduate Certificate in Biomedical Research Ethics requires that 3 of the 9 required hours be earned in BIE 702: Biomedical Research Ethics. Elective courses in each area offer further specialized education and experiential learning opportunities.

In their first semester of study, students typically must enroll in at least one required course prior to or concurrently with taking any elective course or BIE 706/707: Bioethics Seminar.

619. Concepts of Health and Disease. (2 or 3) Concepts of health and disease shape discussions in bioethics and health policy. This course examines and critically evaluates competing conceptions of health and disease. The implications of adopting different understandings of health and disease for bioethics and health policy will be explored. P—POI.

701. Historical Foundation of Bioethics. (2 or 3) Explores the origins of bioethics thought, through examination of core concepts in philosophy, moral theory, social and cultural studies, and law and policy. Topics may include, for instance: the ancient Greeks, Confucius, and key religious teaching on health; the civil rights movement; the history of scientific medicine; and the legal conceptualization of medical practice. This course expands and extends students' knowledge of the contemporary history of bioethics as incorporated in to various aspects of their required courses. P—POI

702. Biomedical Research Ethics. (3) A historical and conceptual survey of ethics and policy issues in biomedical research. Emphasis is on research involving human subjects; translational research, including oversight of novel biotechnologies; and the ethical implications of research design and funding decisions. Topics include the regulatory structure of research and proposals for reform; genomics and biospecimen research; and the relationship between medical research and medical treatment. Students are required to successfully complete two of the following courses: BIE 702, 704, or 705. P—POI.

703. Bioethics Theory. (3) An investigation of the main theoretical approaches to contemporary bioethics and their philosophical foundations. The course begins with the principles of beneficence, autonomy, and justice first propounded in the Belmont Report. Criticisms of and alternatives to what has come to be called the “principlist approach to bioethics” will be critically reviewed. P—POI.

704. Public Policy, Medicine, and Justice. (3) An examination of the organization of medicine and biomedical science in the U.S. today. The relationships between scientific and medical institutions and the implementation of public policies is critically analyzed in light of the requirements of the principle of justice. Topics include conflicts of interest, broadly understood, within and between institutional and professional actors; the regulation of medical practice; access to health care; and the balance between the public good and market forces. Students are required to successfully complete two of the following courses: BIE 702, 704, or 705. P—POI.

705. Clinical Ethics. (3) Focuses on “ethics at the bedside” and makes extensive use of case studies. Emphasis is on patient-provider relationships, broadly understood, and on problems of communication and the social, cultural, and institutional contexts in which they arise. Clinical decision making in a wide range of contexts is examined. Questions of organizational ethics are also considered. Students are required to successfully complete two of the following courses: BIE 702, 704, or 705. P—POI.

706/707. Bioethics Seminar. (1-3) A seminar on bioethics topics of interest featuring Wake Forest University and invited external faculty, with additional student presentations. Participants engage with presenters and scholarly literature on a variety of aspects of bioethics, including, but not limited to, the scholarly and professional practice of bioethics, the role of empirical scholarship in bioethics and related disciplines, the relationship of bioethics to advocacy and policy, and bioethics communication and media. May be repeated for credit. P—POI.

708. Research Methods. (2) An introduction to the methods, concepts, and tools used in quantitative and qualitative empirical research in bioethics. Students develop skills in design, conduct, interpretation, and evaluation of bioethics research. P—POI.

709. Ethics of Health Communication. (3) Topics may include: communication with patients, including truth-telling, confidentiality, and techniques for effective communication; communication within and between institutions, including portable advance directives, access to patient records, and the prevention of medical errors; and communication with the public, including issues arising from the presentation of bioethical issues in news media, film, and television. P—POI.

710. Global Bioethics. (2 or 3) A comparison of American bioethics with the views of other societies and cultures, including western and non-western perspectives. Topics may include: individualism vs. the community, reproductive freedom, organ transplantation, definitions and views of death, access to medical advances, and the use of human subjects in medical research. Other issues include health disparities, justice in research, and the role of humanitarian aid in promotion of global health. P—POI.

711. Current Topics in Clinical and Biomedical Research Ethics. (2 or 3) An in-depth critical examination of selected topics of current interest in clinical and research ethics. Topics are identified by staff and students. Examples of pertinent topics include human pluripotent stem cell research; assisted-reproduction; research without consent; the sale of human organs; pandemic and biodefense preparedness; synthetic body parts and transhumanism; genetic enhancement; regenerative medicine and biogerontology. May be repeated for credit. P—POI.

713. Law, Medicine, and Ethics. (2 or 3) Examination of the relationships between law and medicine, including the legal regulation of medical practice, concepts of medical malpractice, medical neglect, informed consent and legal competence, confidentiality and privacy, and definitions of death. The ethical implications of the intersection of law and medicine are critically analyzed. P—POI.

715. Bioethics and Religion. (3) Explores fundamental themes, methods, and issues in religious bioethics. Seeks to determine the ways that religious approaches offer distinctive, complementary, or overlapping perspectives with secular approaches. Specific topics will include assisted reproductive technologies, family planning and abortion, genetic therapy and enhancement, withholding and withdrawing life-sustaining treatment, suicide and euthanasia, and justice issues in the allocation of health care resources. Combines lectures and discussions with case analysis. P—POI.

717. Ethics, Economics, and Health Policy. (3) Examines ethical and justice aspects of social decision-making and market allocation mechanisms in the context of health care, health policy, and population health. P—POI.

721, 722. Research/Independent Study. (1-3) Students may work with a faculty member on a project of mutual interest. May be repeated for credit. P—POI.

723. Bioethics at the Movies. (2) A critical examination of the bioethical issues raised in selected full length feature films. The goal of this course is to increase students' ability to think critically about complex issues, paying close attention to relevant details. P—POI.

725. Health Care Law and Policy. (2 or 3) Introduces students to the structure, financing, and regulation of the health care system and proposals for its reform. Topics include Medicare, medical staff disputes, health care antitrust, HMOs and insurance regulation. Also listed as Law 525. P—POI.

727. Performable Case Studies in Bioethics. (2 or 3) Students will develop a bioethics case study and present it as a dramatic reading with audience discussion at semester's end. From an initial prompt (e.g. subject matter, situation, incident) and associated readings, the work will be implemented in three phases of approximately equal length: 1) discussion and analysis of the prompt and readings; 2) student presentations of additional research, either individually or in teams, and concomitant discussion and analysis from ethical, social, legal, and, policy perspectives; and 3) script (case) development during in-class writing sessions. The over-arching goal is to exploit the unique ability of dramatic art to engage complex, multifaceted issues in ways that are neither nebulous nor propagandistic, and to highlight the relationship between process, close analysis, art, and scholarship in bioethics. P—POI.

731. Bioethics at Work: The IRB. (1-3) Provides students with the opportunity to experience and understand human research oversight by attending Institutional Review Board (IRB) meetings and reviewing and submitting comments on ethical issues arising in submitted protocols. Students assigned to a single IRB for a single semester will attend 3 to 4 monthly meetings, meet with faculty once per month to review draft comments, and meet with IRB senior staff to discuss submitted comments and other issues immediately before and/or after Board meetings. Students are also required to submit an end-of-semester report and observations, and attend a final class to compare and contrast experiences. Students may also be able to assist in the work of the Research Ethics Consultation Program, by arrangement. Course may be repeated up to a maximum of 4 hours. P—BIE 702 and POI.

733. Bioethics at Work: The Clinical Context. (1-3) Provides students with the opportunity to experience and understand clinical ethics activities in the academic medical center setting, through attendance at Clinical Ethics Committee and Subcommittee meetings and other ethics-related events. Students attend meetings of the WFUBMC Clinical Ethics Committee, the Consultation, Policy, and Organizational Ethics Subcommittees, and educational sessions organized by the Education Subcommittee. Monthly 2-hour meetings with faculty will explore the application of bioethics theory to cases, topics, and issues encountered in clinical settings. Students may also be able to attend ethics consultations by arrangement. Course may be repeated up to a maximum of 4 hours. P—BIE 705 and POI.

757. Biotechnology Law and Policy. (2 or 3) Surveys a range of legal and public policy topics in biotechnology, such as: FDA regulation of drugs and devices, regulation of medical research, product liability, insurance coverage of pharmaceuticals, intellectual property and genetics. Also listed as Law 657. P—POI.

790. Biotechnology and Ethics. (3) With the convergence of medicine, nanotechnology, computer science, molecular biology, genetic engineering, and business, biotechnologies are emerging not only as an important provider of life-saving and life-enhancing treatments but also a fast-growing and very profitable industry. This course explores some of the major ethical issues related to the current and proposed uses of biotechnologies with particular attention to the reasons and arguments that are often used to support various views on the use of biotechnology. Also listed as THS 790. P—POI.

791, 792. Thesis Research. (1-6) Research directed toward fulfilling the thesis requirement. May be repeated for up to a total of 6 credits. P—POI.

794. Bioethics and Law. (2 or 3) Students act as a court or administrative agency and write opinions addressing emerging legal and ethical issues created by society's advancements in medicine and biotechnology, including genetic testing, biomedical experimentation, reproductive rights and end-of-life decisions. Also listed as Law 594. P—POI.

Biology (BIO)

Reynolda Campus

Chair James F. Curran

Reynolds Professor Susan E. Fahrbach

Thurman D. Kitchin Professor of Biology Ronald V. Dimock Jr.

Charles M. Allen Professor of Biology Gerald W. Esch

William L. Poteat Professor of Biology Raymond E. Kuhn

Charles H. Babcock Chair of Botany William K. Smith

Professors David J. Anderson, Carole L. Browne, Robert A. Browne, William E. Conner,

James F. Curran, Herman E. Eure, Kathleen A. Kron, Hugo C. Lane,

Gloria K. Muday, Miles R. Silman, Wayne L. Silver

Associate Professors Miriam A. Ashley-Ross, Erik C. Johnson, Brian W. Tague, Clifford W. Zeyl

Assistant Professor T. Michael Anderson

Research Professors Terry L. Erwin, J. Whitfield Gibbons, Terry C. Hazen, Peter D. Weigl

Research Associate Professor A. Dennis Lemly

Adjunct Assistant Professors Christopher Turner, Michelle DaCosta, Daniel Lewis,

Terri Maness

Teacher-Scholar Postdoctoral Fellows Cheryl Burrell, Anna Kate Lack

The Department of Biology offers programs of study leading to the MS and PhD degrees. For admission to graduate work, the department requires an undergraduate major in the biological sciences or the equivalent, plus at least four semesters of courses in the physical sciences. Any deficiencies in these areas must be removed prior to admission to candidacy for a graduate degree.

At the master's level, the department emphasizes broad biological training rather than narrow specialization. Current research opportunities include physiological ecology, animal physiology, plant physiology, sensory biology, biomechanics, behavioral ecology, plant and animal systematics, immunology, plant and animal cell biology, developmental biology, microbiology, molecular and population genetics, biochemistry and molecular biology, evolution, parasitology, and population and community ecology. It should be noted that graduate students desiring to use work taken in biology for graduate teacher certification should consult the Department of Education before applying for candidacy.

At the doctoral level, few specific requirements are prescribed. Under the guidance of the student's faculty adviser and advisory committee and with the approval of the departmental graduate committee, individual programs are designed for each student. As a supplement to the formal course work, the department has established a special tutorial program. This program brings to campus each year three outstanding biologists to direct and participate in a series of seminars and discussion sessions with doctoral candidates and selected MS students. The areas covered by the tutorial program vary from year to year.

Enrollment in the PhD program is open only to students whose interests are reflected by the areas of expertise represented by the faculty. Thus, prospective PhD students are encouraged to correspond with staff members whose areas of research interest seem compatible with their own. Additional information is available from the chair of the departmental graduate committee.

Graduate study often requires the use of special research tools and skills such as computer work or foreign languages. Candidates for the MS degree must demonstrate proficiency with one such special skill; PhD candidates must be competent with two skills. The student's advisory committee determines, in consultation with the student and with the approval of the departmental graduate committee, the specific areas and demonstrations of competence associated with these skills requirements. Specific coursework in

areas such as biometrics and electron microscopy may be used to satisfy a skill requirement, if approved by the advisory committee.

At least one year of teaching, e.g. as a teaching assistant, is required of all PhD students during their tenure.

In order to remain a bona fide graduate student in the department, the student must maintain an overall B average in all courses attempted. Any time this condition is not met the student will lose all financial support and must reapply for acceptance into the program.

Wake Forest is an institutional member of the Highlands Biological Station, which offers research facilities in a high mountain area rich in transitional flora and fauna. The department has a field station situated on Belews Lake, about twenty miles from the Reynolda campus. Additional opportunities for research are available at the Savannah River Ecology Laboratory.

Study leading to the MS degree was inaugurated in 1961. The PhD degree program began in September 1970. A departmental graduate committee consisting of five members of the biology department, four faculty and one graduate student, oversees all aspects of the graduate program from application review to acceptance to matriculation.

601-605. Topics in Biology. (1-4) Seminar and/or lecture courses in selected topics, some involving laboratory instruction.

607. Biophysics. (3) Introduction to the structure, dynamic behavior, and function of DNA and proteins, and a survey of membrane biophysics. The physical principles of structure determination by X-ray, NMR, and optical methods are emphasized.

614. Evolution. (3) Analysis of the theories, evidences, and mechanisms of evolution.

615. Population Genetics. (4) Study of the amount and distribution of genetic variation in populations of organisms, and of how processes such as mutation, recombination, and selection affect genetic variation. Lectures present both an introduction to theoretical studies and discussion of molecular and phenotypic variation in natural populations.

617. Plant Physiology and Development. (3) Lecture course examining the growth, development, and physiological processes of plants. The control of these processes are examined on genetic, biochemical, and whole plant levels.

617. Plant Physiology and Development. (4) Lecture course examining the growth, development, and physiological processes of plants. The control of these processes are examined on genetic, biochemical, and whole plant levels. Labs consist of structured experiments and an independently designed research project.

620. Comparative Anatomy. (4) Study of the vertebrate body from an evolutionary, functional, and developmental perspective. Labs emphasize structure and function, primarily through the dissection of representative vertebrates.

621. Parasitology. (4) Survey of protozoan, helminth, and arthropod parasites from the standpoint of morphology, taxonomy, life histories, and host/parasite relationships.

622. Biomechanics. (4) Analysis of the relationship between organismal form and function using principles from physics and engineering. Solid and fluid mechanics are employed to study design in living systems, especially vertebrates.

623. Animal Behavior. (4) Survey of laboratory and field research on animal behavior.

624. Hormones and Behavior. (3) Introduction to the hormonal regulation of behavior in a broad range of animals, including humans and invertebrates. Topics include reproductive behavior, parental behavior, social behavior, sex differences, aggressive behavior, stress, mood, and the regulations of molting in insects.

625. Chronobiology. (3) Introduction to the field of biological rhythms, covering different types of rhythms, their evolution, and the mechanisms by which such rhythms are generated and regulated at the molecular, cellular, and system levels.

626. Microbiology. (4) The structure, function, and taxonomy of microorganisms with emphasis on bacteria. Topics include microbial ecology, industrial microbiology, and medical microbiology. Labs emphasize microbial diversity through characterizations of isolates from nature.

631. Invertebrates. (4) Systematic study of invertebrates, with emphasis on functional morphology, behavior, ecology, and phylogeny.

633. Vertebrates. (4) Systematic study of vertebrates, with emphasis on evolution, physiology, behavior, and ecology. Laboratory devoted to systematic, field, and experimental studies.

635. Insect Biology. (4) Study of the diversity, structure, development, physiology, behavior, and ecology of insects.

635S. Insect Biology. (4) A five-week course taught during the summer. A study of the diversity, structure, development, physiology, behavior, and ecology of one of the most diverse taxa on earth. Course location and field trip destinations to be announced each summer. P—POI.

638. Plant Systematics. (4) Study of the diversity and evolution of flowering plants. Lectures emphasize the comparative study of selected plant families, their relationships, and the use of new information and techniques to enhance our understanding of plant evolution. Labs emphasize more practical aspects of plant systematics such as the use of identification keys, recognition of common local plants, molecular techniques, and basic phylogenetic analysis.

639. Principles of Biosystematics. (4) Exploration of the current theoretical and practical approaches to the study of macroevolution in plants and animals. Topics include theory and methods of constructing evolutionary trees, sources of data, and cladistic biogeography.

640. Ecology. (4) Interrelationships among living systems and their environments, structure and dynamics of major ecosystem types, contemporary problems in ecology.

641. Marine Biology. (4) Introduction to the physical, chemical, and biological parameters affecting the distribution of marine organisms.

642. Aquatic Ecology. (4) Designed to cover the general principles and concepts of limnology and aquatic biology as they apply to lentic and lotic habitats. A major portion of the field studies centered at the Charles M. Allen Biological Station.

643. Tropical Ecology. (3) Exploration of the ecology, biodiversity, history, and future of tropical ecosystems. Lectures emphasize ecological principles and rely heavily on the primary literature.

644S. Tropical Marine Ecology. (4) Intensive field-oriented course focusing on tropical marine ecosystems and their biological communities. Emphasis is on biodiversity, the ecology of dominant taxa, the interaction between physical and biological processes, and the structure and function of representative

communities. Includes 2.5 weeks at the Hofstra University Maine Laboratory, Jamaica. Offered during summer school only. (First term/Special term)

646. Neurobiology. (4) Introduction to the structure and function of the nervous system with emphasis on neurophysiology. The labs emphasize traditional electrophysiological techniques with experiments from the cellular to the behavioral level.

647. Physiological Plant Ecology. (3) Designed to provide a fundamental understanding of how plants have adapted to the stresses of their habitats, particularly in harsh or extreme environments such as deserts, the alpine, the arctic tundra, and tropical rain forests.

648. Physiological Plant Ecology. (4) Designed to provide a fundamental understanding of how plants have adapted to the stresses of their habitats, particularly in harsh or extreme environments such as deserts, the alpine, the arctic tundra, and tropical rain forests. The labs introduce students to a broad array of field instrumentation.

6495. Tropical Biodiversity. (4) Intensive field course in tropical biodiversity. Students travel to major tropical biomes, including deserts, glaciated peaks and rain forests. Lectures emphasize the basic ecological principles important in each ecosystem; labs consist of student-designed field projects. Course location varies yearly.

651. Vertebrate Physiology. (4) A lecture and lab course that discusses and demonstrates the principles of bioelectricity and biomechanics. Regulatory principles and the physiology of the cardiovascular, respiratory, and renal systems of vertebrates are covered.

652. Developmental Neuroscience. (4) Focuses on the development of neural structures and the plasticity of the mature nervous system. Special attention is given to experimental model systems, particularly *Drosophila melanogaster*. The labs feature molecular, immunocytochemical, and cell culture techniques for the study of neurons.

654. Endocrinology. (3) Lecture course that explores the evolution of hormones and endocrine glands, and the physiology of the main hormonal pathways of vertebrates.

655. Avian Biology. (4) A lecture and lab course emphasizing ecological and evolutionary influences on the physiology, behavior, and population biology of birds. Includes taxonomy of the world's major bird groups.

659. Genomics. (3) Introduction to the acquisition, analysis, and utility of DNA sequence information. Topics covered include structural, comparative, and functional genomics, genetic mapping, bioinformatics, and proteomics.

660. Development. (4) A description of the major events and processes of animal development, with an analysis of the causal factors underlying them. Special attention is given to the embryonic development of vertebrates, but consideration is also given to other types of development and other organisms. Topics include fertilization, early development, growth and cell division, cell differentiation, the role of genes in development, cell interaction, morphogenesis, regeneration, birth defects, and cancer.

661. Microbial Pathogenesis. (3) Explores the molecular mechanisms by which microorganisms attack hosts, how hosts defend against pathogens, and how these interactions cause disease.

662. Immunology. (3) Study of the components and protective mechanisms of the immune system.

663. Sensory Biology. (3) Lecture course that examines a variety of sensory systems. Emphasis is on sensory physiology, although other aspects of sensory systems, e.g. molecular biology and anatomy, are also covered.

664. Sensory Biology. (4) Lecture and lab course that examines a variety of sensory systems. The emphasis is on sensory physiology, although other aspects of sensory systems, e.g. molecular biology and anatomy, are also covered. In the laboratory, students learn several different procedures which they use to conduct assigned experiments. A final project is required in which students design and carry out their own experiments.

665. Biology of the Cell. (4) Lecture and lab course on recent advances in cell biology. Lectures emphasize analysis and interpretation of experimental data in the primary literature, focusing on topics such as the large scale architecture of the cell, targeting of macromolecules, cell-cell communication, cell signaling, and the control of cell division. The labs introduce basic techniques in cell biology and leads to an independent project.

667. Virology. (3) Designed to introduce students to viruses, viral/host interactions, pathogenicity, methods of control and their use in molecular biology, including gene therapy.

668. The Cell Biological Basis of Disease. (3) Examines some of the defects in basic cellular mechanisms that are responsible for many common and less common diseases. Special topics in cell biology are discussed, and students read original scientific papers correlating these topics with specific disease states.

669. The Cell Biological Basis of Disease. (4) Examines some of the defects in basic cellular mechanisms that are responsible for many diseases. The labs use advanced microscopic and histological techniques to investigate basic properties of cells.

670. Biochemistry: Macromolecules and Metabolism. (3) Lecture course introducing the principles of biochemistry, with an emphasis on the experimental approaches that elucidated these principles. Major topics include structure, function, and biosynthesis of biological molecules, analysis of enzyme function and activity, bioenergetics, and regulation of metabolic pathways.

671. Biochemistry Macromolecules and Metabolism. (4) Lecture and lab course introducing the principles of biochemistry, with an emphasis on the experimental approaches that elucidated these principles. Major topics include structure, function, and biosynthesis of biological molecules, analysis of enzyme function and activity, bio-energetics, and regulation of metabolic pathways. The labs emphasize approaches for isolation of proteins and enzymes.

672. Molecular Biology. (4) Analysis of the molecular mechanisms by which stored information directs cellular development. Emphasis is on storage and transmission of genetic information, regulation of gene expression, and the role of these processes in development. The labs focus on modern techniques of recombinant DNA analysis.

676. Biology of Fishes. (4) Comparative study of the structure/function, classification, and phylogeny of fish.

677. Community Ecology. (4) An advanced ecology course covering mechanisms that determine the dynamics and distribution of plant and animal assemblages: life-history, competition, predation, geology, climate, soils, and history. Lectures focus on ecological principles and theory. Labs include local field trips and discussion of primary literature. Several weekend field trips.

678. Biogeography. (3) Study of geographical, historical, and ecological influences on the distribution, movements, and diversity of organisms. The seminar relies on extensive reading, film, and map work as a basis for class discussions.

680. Biostatistics. (3) Introduction to statistical methods used by biologists, including descriptive statistics, hypothesis testing, analysis of variance, and regression and correlation.

681. Biostatistics Laboratory. (1) Application of computer-based statistical software. Optional laboratory available only to students who have taken or are currently enrolled in BIO 680.

691, 692, 693, 694. Research in Biology. (1, 1, 1, 1) Independent library and laboratory investigation carried out under the supervision of a member of the staff. P—POI.

701-708. Topics in Biology. (1-4) Seminar courses in selected topics, some involving laboratory instruction. At least one offered each semester.

711, 712. Directed Study in Biology. (1, 1) Reading and/or laboratory problems carried out under and by permission of a faculty member.

715. Foundations of Physiology. (1-4) Covers classical and current topics and techniques in comparative physiology. Format varies from seminar to a full laboratory course.

716. Signal Transduction. (2) Focuses on the mechanisms of inter- and intra-cellular communication. Topics range from receptors to signaling molecules to physiological responses. Largely based on the primary literature and requires student presentation of primary research articles. *C. Browne, Muday, Tague*

717. Developmental Mechanisms. (2) Seminar course examining the molecular, biochemical, and cellular mechanisms of animal and/or plant development. Relevant topics selected from the current literature are discussed in lecture and presentation formats.

718. Gene Expression. (2) Seminar covers gene expression in eukaryotic and prokaryotic systems. Topics range from transcription to translation to other aspects of gene regulation. Emphasis is on the experimental basis for understanding the mechanisms of gene expression. Students present, in seminar format, appropriate papers from literature. All students participate in discussion and evaluation of presentations.

725. Plant Genetics. (1,2) Covers various aspects of plant genetics in a seminar format. Topics range from classical Mendelian genetics to genomics and bioinformatics, depending on the interests of the students. Students present the results, conclusions, and significance of appropriate papers from the literature. All students participate in discussion and evaluation of presentations.

726. Plant Physiology. (1, 2) Covers various aspects of plant physiology and hormones in a seminar format. Topics range from auxin transport to properties of light within the leaf. Students present the results, conclusions, and significance of appropriate papers from the literature. All students participate in discussion and evaluation of presentations.

727. Plant Evolution. (1,2) Covers various aspects of plant evolution in a seminar format. Topics range from problems in phylogeny reconstruction and patterns of diversity to major evolutionary innovations in various plant groups. Students present the results, conclusions, and significance of appropriate papers from the literature. All students participate in discussion and evaluation of presentations.

728. Plant Ecology. (1,2) Covers various aspects of plant ecology in a seminar format. Topics vary depending on graduate student interest. Students present the results, conclusions, and significance of appropriate papers from the literature. All students participate in discussion and evaluation of presentations.

730. Invertebrate Zoology. (4) Emphasis on the physiology and ecology of invertebrate animals.

736. Bioacoustics. (4) Analysis of the mechanisms of sound production, transmission, and reception and their relevance to animal orientation and communication.

740. Physiological Ecology. (4) Introduction to evolutionary/ecological physiology, with emphasis on the interactions between organisms and major abiotic factors of the environment including, water balance—hydration, gaseous exchange—respiration, temperature tolerance—thermal physiology.

757. Techniques in Mathematical Biology. (3) Offers students a framework for understanding the use of mathematics in both biological theory and empirical research. Emphasis is on practical applications of mathematical techniques, and learning by doing. A central goal is to give students tools to use in their own research. Topics covered include continuous and discrete population models, matrix models, stochastic models, life-history theory, and fitting models for data. Mathematical skills are taught and refreshed, but knowledge of basic calculus is required.

762. Immunology. (4) Humoral and cellular immune responses are examined to understand the basic immunobiology of vertebrates with special emphasis on cell-cell interactions and immunoregulation. Labs introduce students to basic methods in immunological research.

763. Cellular and Molecular Interactions Between Hosts and Parasites. (3) Examines the responses of animal hosts in attempting to immunologically and non-immunologically reject/control both endo- and ecto-parasites and responses of these parasites to the host environment. Consists of lectures and student presentations and requires a comprehensive review article by students.

764. Sensory Biology. (4) Lecture and lab course involving a study of energy in the environment and how it is absorbed and transduced in sensory systems. Anatomical, physiological, biochemical, and biophysical approaches are integrated in the study of sensory mechanisms in plants and animals. A lab project implementing the scientific method and designed to produce new knowledge is required.

767. Foundations of Ecology. (3) A graduate seminar focusing on understanding the seminal developments in the field of ecology and then tracing their intellectual impacts on the modern literature.

775. Microscopy for the Biological Sciences. (4) Introduction to the various types of light, confocal, and electron microscopy. Students learn technical and theoretical aspects of microscopy, methods of sample preparation, digital image acquisition and analysis, and the preparation of publication quality images. Emphasizes practical applications of microscopy, microscopy experimental design, and hands-on use of microscopes and digital imaging systems. Students are expected to design and conduct a microscopy project and present their results to the class. Additionally, students are expected to participate in class discussions regarding newly emerging microscopy techniques in various biological disciplines.

777. Biophysical Ecology. (4) Designed to introduce students to the interactions of the organism with the physical environment. Sunlight, temperature, water availability and humidity, wind, and longwave radiation (greenhouse effect) strongly influence an organism's growth and reproductive potential. Differences in heat and mass transfer to and from the organism, plus corresponding organism responses in structure, physiology, and behavior to changes in the local environment, are addressed. These same principles are also important to the design of energy-efficient homes (passive solar), clothing design (Gortex), outdoor survival and gardening, to name only a few of humankind's everyday activities.

778. Advanced Ecology. (4) Covers current research in the field of ecology with a focus at the community level. Experimental design, data analysis, and interpretation are emphasized.

779. Molecular Techniques in Evolution and Systematics. (4) Lecture and lab course that explores molecular methods that are basic to many disciplines within biology, especially ecology, evolution, and systematics. Labs focus on the acquisition of molecular techniques, including allozyme electrophoresis, mitochondrial plastid, and nuclear DNA restriction fragment length polymorphism analyses, gene amplification, PCR (polymerase chain reaction), direct and/or cycle sequencing, and RAPDS (randomly amplified polymorphic DNAs).

780. Advanced Systematics. (3) Literature-based course that covers various subdisciplines within systematics including cladistic biogeography, history and theory of systematics, analytical techniques and database management of systematic data.

782. Behavioral Ecology. (3) Lecture course analyzing behavioral solutions to challenges faced by animals in nature, emphasizing the role of natural selection in shaping behavior. Topics include mating systems, optimal foraging, sociobiology, parental care, and evolution of sexual reproduction.

783. Teaching Skills and Instructional Development. (3) Introduction to teaching college-level science courses. Emphasis is on: defining and achieving realistic course goals; mechanics of selecting, developing and refining topics for lecture or laboratory; effective presentation strategies; and creating an active learning environment. Students develop a teaching portfolio containing course syllabi, lecture outlines, and student-ready laboratory materials. Format combines didactic lectures, individual projects, and group discussions and critiques. Course meets for two, 2-hour periods each week.

791, 792. Thesis Research. (1-9)

793. Summer Research. A course for summer research by continuing graduate students working with their adviser.

891, 892. Dissertation Research. (1-9)

Biomedical Engineering (BMES) Track 7

Bowman Gray Campus

Interim Chair Craig Hamilton

Professor Peter Santago, Joel D. Stitzel, Ge Wang

Associate Professors Craig A. Hamilton

Assistant Professors Scott Gayzik, Yaorong Ge, Katherine R. Saul, Robert A. Kraft, Aaron Mohs, Jessica L. Sparks

Associate Faculty J. Daniel Bourland, David L. Carroll, H. Donald Gage, Michael T. Munley, Robert J. Plemmons

The Department of Biomedical Engineering offers PhD and MS degrees in biomedical engineering in conjunction with the joint degree program in the Virginia Tech–Wake Forest University School of Biomedical Engineering and Sciences (SBES). The program emphasizes medical applications, particularly in image and signal processing and analysis, regenerative medicine/tissue engineering, biomechanics, and medical physics. Qualified applicants should have undergraduate degrees in technical fields, including engineering, computer science, mathematics and physics. Additional training in life sciences is desirable but not essential.

The program consists of traditional classroom instruction, independent research with a mentoring team, and clinical experience. For the MS degree, students must take a minimum of 21-23 course credit

hours and 7-9 hours in research for a minimum of 30 credit hours. For the PhD degree, 90 credit hours must be taken, of which 40-54 hours are dissertation research. Courses for both degrees come from engineering and life science core courses and selected electives in engineering, life sciences, and related physical sciences. The program is very flexible, and selection of elective courses can be individualized to complement the student's background and interests; and offerings include courses in the physics, mathematics, and computer science departments.

A clinical rotation is offered to PhD students following their first year of study. Students are exposed to technical equipment with medical applications; and to patient care and procedures used in medical centers, thus providing relevance and context for their classroom studies and research.

Office and laboratory space are located throughout the Medical Center and include the Image Analysis Lab, the Movement Biomechanics Lab, the Tissue Mechanics Lab, the Center for Injury Biomechanics, the Wake Forest Institute for Regenerative Medicine, Radiation Oncology, Plastic and Reconstructive Surgery, and others. Facilities also include a chemistry lab and a machine shop with associated instrumentation and tools. Academic space is provided in the Magnetic Resonance Imaging Building. Computer and network facilities are state of the art, and several projects utilize the cluster computer facility, the DEAC Cluster. Associated labs in clinical and basic science departments also provide equipment for student research.

More information is available on the website, www.sbes.vt.edu. Prospective students are encouraged to contact individual faculty members or schedule a visit to the department.

600. Mammalian Physiology. (4) Topics include cell biology, neurological and muscle physiology, autonomic nervous system, cardiovascular system, cardiac function and hormonal regulation, pulmonary system, renal system, endocrinology, gastrointestinal system, glucose and lipid storage.

601. Quantitative Physiology. (3) Provides an overview of mathematical modeling, simulation, and quantitative descriptions of organ physiology. Topics include cell resting membrane potential, regulation of cardiac output, venous return, pressure-volume behavior of alveoli and respiratory ventilation control, nephron countercurrent mechanisms, hemodialysis, metabolism, and internal heat generation/temperature regulation. P—BMES 600.

602. Biomedical Engineering and Human Disease. (3) Comprehensive overview of a variety of human diseases, including neurological disorders, cardiovascular disease, infectious disease, and cancer, designed primarily for graduate students majoring in engineering and other related areas who have a long-term academic and professional goal in the field of biomedical engineering and life sciences. Introduction to state-of-the-art biomedical engineering approaches used for the study of early detection/diagnosis, treatment, and prevention of human disease. P—BMES 600.

610. Engineering Analysis of Physiologic Systems I. (3) Engineering analysis of human physiology. Physiologic systems are treated as engineering systems with emphasis on input-output considerations, system interrelationships and engineering analogs. Also studied are mass and electrolyte transfer, nerves, muscles and renal system. P—POI.

611. Engineering Analysis of Physiologic Systems II. (3) Engineering analysis of human physiology. Physiologic systems are treated as engineering systems with emphasis on input-output considerations, system interrelationships and engineering analogs. Also studied are cardiovascular mechanics, respiratory system, digestive systems, and senses. P—POI.

612. Musculoskeletal Biomechanics and Biologic Control. (3) Static and dynamic forces in the musculoskeletal system, joint reactions, and prosthetic joint design and replacement. Soft and hard tissue response to force loads. Muscle mechanics. Biomechanical lumped parameter systems: modeling and

frequency response. Spatially distributed biomechanical models. Feedback control (closed-loop control) of biomechanical systems. P—POI.

613. Biomechanics and Simulation of Movement I. (3) Key topics in movement biomechanics, including muscle physiology and mechanics, neural control, kinematic and dynamic modeling, and dynamic simulation. Discussion of real-life applications in medicine and sports, and practical experience using engineering equipment (motion capture and EMG) and software used in research and industry to analyze human movement.

616. Advanced Impact Biomechanics. (3) Review of impact biomechanics and critical investigation of the impact response of the human body. Participants study the dynamic response of the head, neck, chest, abdomen, upper and lower extremities. Real-world examples from automobile safety, military applications, and sport biomechanics. P—POI.

617. Biomechanics of Crash Injury Prevention. (3) Presents an introduction to the design and analysis of crash injury prevention methods in vehicle crashes. Encompasses three major focus areas: crash energy absorption in (1) the vehicle structure, (2) the occupant, and (3) the occupant restraints.

618. Injury Physiology. (3) Presents an introduction to the physiology of injury. Focuses on the pathophysiology, mechanisms, and outcomes of injury in mammalian tissues. Explores injury physiology at the organ, tissue, and cellular level. Topics include physiology of injury to tissues of the peripheral and central nervous systems, the musculoskeletal system, the pulmonary system, the abdomen, the pregnant female, and the eye.

620. Work Physiology. (3) Anthropometry, skeletal systems, biomechanics, sensorimotor control, muscles, respiration, circulation, metabolism, climate. Ergonomic design of task, equipment, and environment. P—POI.

621. Human Physical Capabilities. (3) Examination of human physical attributes in human-technology systems, with emphasis on models of anthropometry and biomechanics, on intero- and exteroceptors, and on the work environment; force fields (transitory and sustained), sound, light, and climate. P—POI.

624. Biofluids. (3) Fluid dynamics of physiological systems with focus on cardiovascular and respiratory systems. Addresses the heart, arterial blood vessels, airways; cardiac and pulmonary circulation; anatomy and function of the heart and respiratory systems; mechanics of soft tissues; basic fluid mechanics; continuum mechanics and constitutive modeling; rheology of blood, Newtonian and non-Newtonian; viscous flow in vessels, Navier-Stokes; mathematical analysis of pulsatile flow; pulse-wave propagation through vessels; particulate flows and particle transport on airways. P—POI.

625. Biomechanics of the Cardiovascular System II. (3) Rheology of blood; hematology; elasticity of blood vessel walls; transport processes; control of the circulation; mathematical analysis of pulsatile blood flow and pulse-wave propagation through small arteries, capillary beds and extra-corporeal devices. P—POI.

630. Biological Transport Phenomena. (3) The fundamental principles of mass transport phenomena are introduced and applied to the characterization of transport behavior in biological systems (e.g. cell, tissues, organs, people). Topics include active, passive, and convective molecular transport mechanism. These fundamentals will be used to develop analytical and predictive models and describe phenomena such as oxygen transport, kidney function, systemic drug delivery, and design of extracorporeal devices. P—Undergraduate courses in fluid mechanics and transport phenomena.

631. Introduction to Regenerative Medicine I. (2) The course explores the current state of the field of regenerative medicine with specific emphasis on the technological challenges that limit the efficacy and clinical translation of engineered tissues and therapies. Course content will be presented from both the life science (e.g., cell biology, organ physiology, biochemical methods) and engineering perspective (e.g. transport phenomena, materials engineering) to compare and evaluate alternative approaches and strategies that are being developed and tested. Emphasis is placed on the promising roles of stem cells, biologically-inspired materials, and gene therapies. P—Graduate standing or consent of instructor. Undergraduate biology and calculus are suggested.

641. Biomaterials. (3) Lectures and problems dealing with materials used to mimic/replace body functions. Topics include basic material types and possible functions, tissue response mechanisms, and considerations for long-term usage. Issues of multicomponent materials design in prosthetic devices for hard and soft tissues are discussed.

642. Fundamentals of Tissue Structure, Function, and Replacement. (2) Descriptions of the structures of tissues such as skin, bone, ligament, cartilage, and blood vessels. Relationships between the structures of these tissues and their functions. Descriptions of the components of these tissues and their mechanical properties. Introduction to tissue mechanics and mathematical modeling of tissue behavior. Introduction to mechanical testing methods of hard and soft tissues. Methods for tissue replacement.

651. Digital Signal Processing. (3) The fundamentals of digital signal processing of data experimentally obtained from mechanical systems is covered. Attention is given to data acquisition, A/D conversion, aliasing, anti-aliasing filtering, sampling rates, valid frequency ranges, windowing functions, leakage, and various transform methods. Special attention is given to random, transient, and harmonic function data processing. Various methods of estimation of frequency response function (FRF) are explored. The estimation methods are assessed as to their impact on FRF estimation errors.

652. Stochastic Signals and Systems. (3) Engineering applications of probability theory, random variables and random processes. Time and frequency response of linear systems to random inputs using both classical transform and modern state space techniques.

655. Biomedical Signal and Image Processing. (3) The mathematical theory underlying the processing of one and two dimensional signals, including Fourier transforms, sampling, quantization, correlation, and filtering. For images, the topics of segmentation, restoration, enhancement, color, and registration will be explored. Matlab projects will be utilized extensively, with an emphasis on biomedical signals and images.

671. Biomedical Microdevices. (3) Builds the foundation necessary for engineering research in micro- and nano- biotechnology. Covers micro- and nano-fabrication techniques; the fundamentals of microfluidics; micro- and nano-particle manipulation; and engineering aspects of cells and their membranes. Provides students with the knowledge required to create biomedical micro- and nano-devices with a focus on the unique physics, biology and design aspects at these scales. Students are expected to know undergraduate engineering, physics, and calculus.

697. Independent Study. (3) Opportunity to pursue a topic covered in a regular course in greater depth. Usually involves extensive reading and tutorial sessions with a faculty supervisor. Written papers may be required.

698. Special Study. (3) Designed for a group of students. It may be used to study a timely topic—one in which there is current, but not necessarily lasting interest. It also may be used to launch an experimental course before the course is incorporated into the regular curriculum.

706. Clinical Rotation. (2) Offers both a broad view of the use of engineering principles in medicine and general clinical care, together with an in-depth study of a particular aspect of medicine under the direct supervision of a physician. The student sees the operation and maintenance of various clinical modalities, systems, and devices under the guidance of a working engineer or technician. Students participate in clinical rounds and in image reading sessions to gain insight into the actual operation and needs of departments using medical imaging modalities.

708. Topics in Biomedical Engineering. (1-6) Topics in biomedical engineering that are not considered in regular courses. Content varies.

712. Biodynamics and Control I. (3) Application of dynamics and control theory for analysis and simulation of human movement. Topics include dynamics of muscle contraction, forward-dynamic simulation of human movement, stability, neuromotor control feedback and robotics. Students are exposed to clinical problems in orthopedics and rehabilitation. P—POI.

713. Biodynamics and Control II. (3) Applied laboratory-based investigation and research design of human movement-control through state-of-the-art measurement techniques. Upon completion, students will be able to implement state-of-the-art measurement techniques to quantify dynamic movement and neuromuscular control in human subjects; propose and develop biomechanical protocols for validation of computational simulation hypotheses of neuromuscular dynamics and control; construct physical models of the human neuromechanical system for demonstration of physiologic hypotheses relating to movement limitations or dysfunction. P—BMES 712.

716. Computational Modeling in Impact Biomechanics. (3) Dynamic modeling of the human body subjected to impact loading. A combination of finite element analysis and multi-body simulation techniques. Utilizes software packages with dynamic solvers. Applications include computer-aided design for automobile safety, sports, biomechanics, and military restraint systems.

717. Advanced Human Modeling: Injury and Tissue Biomechanics. (3) Serves as a continuation of BMES 616 and BMES 716. It covers the basics of the finite element method as it applies to high-rate phenomenon. Focus is on practical problems and the use of commercial codes for solving vehicle crash-worthiness and biomechanics problems. Real-world examples from biomedical engineering, automobile safety, military applications, and sport biomechanics are used to augment lecture material. P—BMES 616 and 716.

750. Medical Imaging I. (3) First part of a two-semester sequence that covers medical imaging modalities from an engineering and signal processing viewpoint. Included, however, is much of the underlying physics of the modalities. The course covers MR imaging, X-ray, and X-ray physics, and an introduction to computerized tomography. Topics include underlying physical processes, data acquisitions, sampling and quantization, and clinical applications. Each modality is reviewed in the context of its underlying physical processors as well as a common model describing such basic imaging parameters as resolution, contrast, and noise.

751. Medical Imaging II. (3) Study of several medical image modalities, including magnetic resonance (MR) imaging, positron emission tomography (PET), single photon emission computed tomography (SPECT), computer tomography (CT), and ultrasound; taught from signal processing point of view. Topics include an overview of the underlying physical processes, data acquisition, sampling, and quantization; image reconstruction techniques; relationships between the various modalities; and clinical and industrial applications.

758. Biomedical Pattern Recognition. (2) Study of image pattern recognition techniques and computer-based methods for scene analysis, including discriminant functions, feature extraction, classification strategies, clustering, and discriminant analysis. Applications to medicine and current research results are covered. P—BMES 655 or equivalent.

759. Advanced Image Analysis. (3) An overview of current trends in image analysis with in-depth studies of topics particularly relevant to medical imaging. Students analyze and report on current literature. Computer-oriented projects allow students to implement several analysis algorithms. Topics include statistical parameter mapping, expectation maximization, Markov random fields, fuzzy set methods, and methods which incorporate prior knowledge. Emphasis is on defining image analysis problems in a cost minimization/optimization setting. Experience with an appropriate programming tool such as Matlab or IDL is required. A prior course in optimization is useful. P—BMES 652, 752, 758.

770. Radiation Therapy Physics. (3) The physics of radiation treatment including: radiation producing equipment, character of photon and electron radiation beams, radiation dose functions, computerized radiation treatment planning, brachytherapy, special radiation treatment procedures, quality assurance, and radiation shielding for high energy facilities.

797, 798. Research. (1-9)

Cancer Biology (CABI)

Bowman Gray Campus

Chair Frank M. Torti

Professors Steven A. Akman, Yong Chen, William H. Gmeiner, Mark S. Miller, Frank M. Torti

Associate Professors Steven Kridel, George Kulik, Lance Miller, Gary Schwartz

Assistant Professors Darren F. Seals, Guangchao Sui, James Vaughn, Thad Wadas

Research Assistant Professors Zhennan Gu, Jin Woo Kim

Associate Faculty Rebecca Alexander, Ulrich Bierbach, David Carroll, Zheng Cui, Waldemar Debinski, Purnima Dubey, Patricia Gallagher, Martin Guthold, Kazushi Inoue, Paul B. Jones, S. Bruce King, Gregory L. Kucera, Timothy E. Kute, Frank Marini, Linda Metheny-Barlow, Akiva Mintz, Charles S. Morrow, David A. Ornelles, Timothy S. Pardee, W. Jeffrey Petty, Michael Robbins, Freddie Salisbury, Shay Soker, Ann Tallant, Suzy Torti, Alan Townsend, Yuh-Hwa Wang, Mark Welker, Jianfeng Xu, Siqun Lilly Zheng

The cancer biology graduate program was established in 1997. The graduate training program of the Department of Cancer Biology is designed to prepare students for future research careers focused on the issues relevant to human cancer. All applicants are required to have taken the general Graduate Record Exams prior to admission to the cancer biology graduate program. Subject tests are not required. Applicants must have completed college-level fundamental courses in biology, and general and organic chemistry. Courses in physics and mathematics through calculus are encouraged, but not required.

Students enter the Cancer Biology training program through the Molecular and Cellular Biosciences track. During the first year, in addition to the MCB common curriculum, students considering the Cancer Biology training program should consider taking one or more of the following electives: MCB 721 Carcinogenesis, DNA Damage and Repair, MCB 722 Molecular Pathogenesis of Cancer, MCB 723 Topics in Cancer Biology. If not taken as electives in Year 1, students matriculating in the Cancer Biology

training program will be required to complete these courses in subsequent years. Additional course work in subsequent years will include Advanced Topics in Cancer Biology, Statistical Experimental Design, Tutorials in Cancer Biology, and an elective course of the students' choice. Students also participate in the Cancer Biology Research in Progress seminar series.

The following electives are offered through the MCB Track:

MCB 721. Carcinogenesis, DNA Damage and Repair. (2) This course will cover the identification and reaction mechanisms of environmental carcinogens, DNA damage and mutagenesis by endogenous and exogenous agents, and the mechanisms of DNA repair.

MCB 722. Molecular Pathogenesis of Cancer. (2) Fundamental molecular changes in cells and tissues that contribute to the malignant phenotype are discussed. Topics include alterations in genes and chromatin, signaling pathways, tumor cell metabolism, and the tumor microenvironment.

MCB 723. Topics in Cancer Biology. (2) Teaches students how to evaluate and communicate scientifically in the area of cell biology and cancer. Examples are taken from all areas of cancer in this advanced course. Uses current peer-reviewed journal articles to teach fundamental concepts and act as a medium for allowing the students to communicate ideas with an emphasis on presentation skills.

The following advanced courses in CABI are offered:

705. Cancer Cell Biology. (3) This is an intensive treatment to learn how to critically review the literature and requires the writing of a proposal that is critically reviewed. The course covers apoptosis, cell-cycle, angiogenesis, cancer genomics, metastasis, cancer immunology, and tumor suppressor genes. The translational aspects of research are emphasized.

707, 708. Topics in Cancer. (1) A weekly lecture series taken during the second year. Each week throughout the fall and spring semesters, a different topic in the clinical presentation, course, and treatment of human malignancies is presented. Designed to be a comprehensive overview of clinical oncology for clinical medical and radiation oncology fellows and cancer biology graduate students.

711, 712. Advanced Topics in Cancer Biology. (1) Focuses on new and important aspects of research in cancer biology with an emphasis on the current literature. Themes are chosen by the course director and the students. A topic is selected for presentation by each student; with the help of the course director, the student prepares a short lecture to introduce the topic, assigns two key papers for participants to read, and provides a supplemental reading list. The following week, the student leads a discussion of key experimental findings. Broad participation from faculty, postdoctoral fellows, and graduate students is encouraged. Pass/fail only.

713, 714. Cancer Biology Tutorials. (2) Focuses on specific topics related to cancer predisposition, development, progression, and treatment. Topics include, but are not limited to, DNA damage and repair, damage signaling, cell death response, cell cycle checkpoint control, animal models and cancer treatment. The purpose of the tutorial is to provide an opportunity to discuss one of the above-mentioned topics in more detail than is possible in an overview-based lecture. The topic for upcoming semesters will be determined by the faculty. The class is a combination of lectures providing background information and student presentations introducing specific topics and related research articles in the field, followed by group discussions. Attendance and at least one full length presentation are mandatory to obtain credit.

716. Special Topics: Teaching in the Small Group Setting. (2) Teaches students how to use a problem-based interactive approach to facilitate student self-learning. Introduces students to general methods of teaching with a focus on teaching in the small group setting of a literature-based course. Topics covered include teaching skills for reading scientific papers, oral presentation techniques, and scientific writing. Each student facilitates two weeks (4 class sessions) of the course including in-class participation as well as assisting with the written evaluation portion of the class.

717. Advanced Cancer Cell Biology. (2) This literature-based course covers fundamental cell biology principles related to cancer. Students select recent papers from the top-tier journals in the field. Papers are selected that use model organisms and systems. These can include human, mouse, flies, worms, yeast, and fish. Students are expected to participate in round table discussions of the merits, deficiencies, and impact of the work. Students are evaluated on paper selection, contributions to discussions, and ability to critically evaluate the material. P—POI.

718. Introduction to Radiation Biology. (3) Focuses on the biological changes which follow the interaction of ionizing and non-ionizing radiation with living matter. Emphasis is on the role of ionizing radiation in the treatment of cancer, mechanisms of radiation-induced carcinogenesis, and changes in normal and tumor cells at the molecular, cellular and tissue levels.

723, 724. Research in Cancer Biology. Opportunities for investigation in a variety of the facets of cancer biology under the guidance of staff members.

Chemistry (CHM)

Reynolda Campus

Chair Christa L. Colyer

John B. White Professor of Chemistry Willie L. Hinze

Thurman D. Kitchin Professor of Chemistry Dilip K. Kondepudi

William L. Poteat Professor of Chemistry Mark E. Welker

Professors Christa Colyer, Bradley T. Jones, S. Bruce King, Abdessadek Lachgar, Ronald E. Noftle

Associate Professors Rebecca W. Alexander, Ulrich Bierbach, Paul B. Jones, Akbar Salam

Assistant Professors Patricia C. Dos Santos, Lindsay R. Comstock

The Department of Chemistry offers programs of study leading to the MS and PhD degrees. Opportunities for study in courses and through research are available in analytical, biological, inorganic, organic, and physical chemistry. Research plays a major role in the graduate program. Since the number of graduate students is limited, the research program of the individual student is enhanced by close daily contact with the faculty.

All applicants for graduate work in the department are expected to offer as preparation college-level fundamental courses in general, analytical, organic, inorganic, and physical chemistry; physics; and mathematics through one year of calculus. During registration all new graduate students take qualifier examinations covering the fields of analytical, biological, inorganic, organic, and physical chemistry. Programs of study are in part determined by the results of these examinations, and deficiencies are to be remedied during the student's first academic year.

For the MS degree, the student is expected to undertake a broad program of coursework at an advanced level and to complete successfully an original investigation. This investigation must be of the

highest quality but necessarily limited in scope. Students who hold assistantships normally spend two years in residence for the completion of this degree.

For the PhD degree, individual programs are designed for each student under the guidance of the student's faculty adviser and advisory committee and with the approval of the graduate committee.

The University preliminary examination requirement is satisfied by successful completion of a series of written cumulative examinations and by presentation of two research proposals, one of which is the dissertation research project. Each student is to present two departmental seminars, one of which will be on the results of his or her dissertation research. The student must present a dissertation and pass an examination on it as prescribed by the Graduate School, and other University requirements must be satisfied.

The chemistry program participates in the Interdisciplinary Graduate Track in Structural and Computational Biophysics. For more information, refer to the pages in this bulletin regarding the program.

The original graduate program, which led to the MS degree, was discontinued in 1949. The present MS program was begun in 1961, the PhD in 1972.

Graduate courses offered by the Department of Chemistry are from the following list. Not all courses are offered every year.

***623. Organic Analysis.** (4) The systematic identification of organic compounds.

***625, 626. Organic Synthesis.** (4, 4) Reagents for and design of synthetic routes to organic molecules.

***634. Chemical Analysis.** (3 or 4) Theoretical and practical applications of modern methods of chemical analysis. C—CHM 641.

***641, 642, 644. Physical Chemistry.** (3 or 4) Fundamentals of physical chemistry.

648. Electronic Structure Theory and Computational Chemistry I. (3) Introduction to quantum mechanical foundation of electronic structure theory and its application to problems in computational chemistry.

651. Special Topics in Biochemistry. (3) Fundamentals of biochemistry, with particular emphasis on mechanistic analysis of metabolic pathways, enzymatic activity, and drug action.

***656, 657. Chemical Spectroscopy.** (1.5, 1.5) Fundamental aspects of the theory and application of chemical spectroscopy, as found in the areas of analytical, inorganic, organic, and physical chemistry. Emphasis varies. Seven week courses. P—CHM 642 or 644, 661, or POI. May be repeated.

666. Chemistry and Physics of Solid State Materials. (3) Describes basic principles of solid state chemistry. Focuses on the design, synthesis, structure, chemical, and physical properties and the application of solid state materials. The relationships between electronic structure, chemical bonding, and crystal structure are developed. Case studies are drawn from materials for energy generation and storage, e.g. batteries and fuel cells, and from emerging technologies, e.g., nano- and biomaterials.

661. Inorganic Chemistry. (3 or 4) Principles and reactions of inorganic chemistry. C—CHM 641.

664, 664L. Materials Chemistry. (3, 1) A survey of inorganic-, organic-, bio-, and nano-materials, including hybrid materials and applications. P—CHM 641 or POI.

670. Biochemistry: Macromolecules and Metabolism. (3) A lecture course introducing the principles of biochemistry, with emphasis on the experimental approaches that elucidated these principles.

**Departmental graduate committee approval required.*

Major topics include structure, function, and biosynthesis of biological molecules, analysis of enzyme function and activity, bioenergetics, and regulation of metabolic pathways.

672. Biochemistry: Protein and Nucleic Acid Structure and Function. (3) Special topics in biochemistry, including catalytic mechanisms of enzymes and ribozymes, use of sequence and structure databases, and molecular basis of disease and drug action. P—CHM 670 or POI.

681, 682. Chemistry Seminar and Literature. (.5, .5) Discussions of contemporary research and introduction to the chemical literature and acquisition of chemical information.

701. Advanced Physical Chemistry. (3) An accelerated survey of classical and statistical thermodynamics, chemical kinetics, and quantum chemistry.

711, 712. Directed Study in Chemistry. (1 or 2, 1 or 2) Reading and/or lab problems carried out under supervision of a faculty member. P—Permission of graduate committee.

721. Advanced Organic Chemistry. (3) An accelerated survey of organic reactions and mechanisms.

722. Physical Organic Chemistry. (3) Physical methods for determining structure-activity correlations and reaction.

723. Transition-Metal Organic Chemistry. (3) Introduction to principles of bonding in organometallic chemistry and organometallic reaction mechanisms. Uses of transition-metal complexes in organic synthesis.

724. Organic Synthesis. (3) Modern principles of organic synthesis and retrosynthetic analysis. Stereoselective synthesis of complex natural products.

725. Structure Identification in Organic Chemistry. (3) Theory and use of spectroscopic techniques for structural identification of organic compounds.

726. Reactive Intermediates. (3) Mechanistic and preparative photochemistry. Structure and chemistry of excited states, free radicals, carbenes, and selected ions.

734. Advanced Analytical Chemistry. (3) Principles and practical applications of analytical methods, with particular emphasis on modern spectral methods, electroanalytical methods, and chemical separations.

735. Spectrochemical Analysis. (3) Principles of atomic and molecular spectrometric methods; discussion of instrumentation, methodology, and applications.

736. Chemical Separations. (3) Theory and practice of modern separation methods with emphasis on gas and liquid chromatographic techniques.

737. Electrochemical Processes. (3) Principles of electrochemical methods, ionic solutions, and electrochemical kinetics.

738. Statistics for Analytical Chemistry. (3) Practical investigation of the statistical procedures employed in modern analytical chemistry.

740. Drug Discovery, Design, and Development—Molecules to Medicines. (3) Conducted as a combination of lectures, reading assignments, and student-led discussions. Examines drug discovery and development pathways from target and lead compound identification through metabolic and toxicology studies, clinical trials, FDA approval, and marketing. Regulatory processes, intellectual property, and ethical issues are also considered. Taught by WFU faculty from both the Reynolda and Bowman Gray campuses and colleagues in the pharmaceutical and biotechnology industries, students work in teams to

present case studies on the discovery, development, and marketing of recently approved pharmaceuticals. Also listed as BICM 740. P—Organic chemistry and biochemistry.

745. Statistical Thermodynamics. (3) The application of statistical mechanics to chemistry to understand and predict the thermodynamic properties.

746. Chemical Kinetics. (3) Kinetics and mechanisms of chemical reactions; theories of reaction rates.

747. Self-Organization in Nonequilibrium Chemistry. (3) Study of the phenomena of self-organization, such as oscillations, multistability, propagating waves, and formation of spatial patterns. Kinetic systems with autocatalysis will be studied using bifurcation theory and other methods of non-linear systems.

751. Biochemistry of Nucleic Acids. (3) Survey of the structure, reactivity, and catalytic properties of RNA and DNA, including modern experimental techniques.

752. Protein Chemistry: Structures, Methods, and Molecular Mechanisms. (3) Advanced survey of protein biochemistry with an emphasis on structural families, enzyme catalytic mechanisms, expression and purification methods, and biophysical and structural experimental techniques.

753. Chemical Biology. (3) Survey of the origins and emerging frontiers of chemical biology, with a focus on the impact of chemical methods on our understanding of biology. Topics include protein design, chemical genetics, and methods in genomics and proteomics research.

756. Biomolecular NMR. (1.5) One-half semester course designed for graduate and advanced undergraduates focusing on NMR of small oligonucleotides and proteins. Covers sample preparation, data acquisition and processing as well as generating solution structures from NMR data. A student should have command of 1D acquisition and processing as well as experience with 2D acquisition and processing before taking this class. All computational exercises involve some familiarity with the UNIX operating system. P—POI.

757. Macromolecular Crystallography. (1.5) One-half semester course designed for graduate and advanced undergraduates focusing on structural characterization of macromolecules utilizing X-ray crystallography. Covers sample preparation, diffraction theory, data acquisition and processing as well as structure solution and refinement techniques. P—CHM 656 highly recommended.

761. Chemistry of the Main Group Elements. (3) Principles of bonding, structure, spectroscopy, and reactivity of compounds of the main group elements. Synthesis and applications of organometallic compounds of the main group.

762. Coordination Chemistry. (3) Theory, structure, properties, and selected reaction mechanisms of transition metal complexes. Design and synthesis of ligands and their applications in bioinorganic chemistry.

764. Chemical Applications of Group Theory and Symmetry. (3) Symmetry, group theory, bonding, and spectroscopy. Applications to structure, stereoisomers, multicenter bonding and symmetry-controlled reactions.*e*

765. Bioinorganic Chemistry. (3) The inorganic chemistry of life. a) Metals in biocatalysis: elucidation of structure and function of metalloenzymes by various spectroscopic and molecular biology methods; biomimetic ligands; synthetic models of active sites. b) Metals and toxicity. c) Inorganic compounds in therapy and diagnosis.

771. Quantum Chemistry. (3) The quantum theory and its application to the structure, properties, and interactions of atoms and molecules. Theoretical and computational approaches.

791, 792. Thesis Research. (1-9, 1-9)

829. Tutorial in Organic Chemistry. (3)

830. Heterocyclic Chemistry. (3) Survey of the major groups of heterocyclic compounds. Modern applications of heterocycles.

831. Principles of Chemical Carcinogenesis. (3) Fundamental chemistry of carcinogenesis. Survey of the chemistry and structure of carcinogenic compounds. Defense and chemotherapeutics.

832. Theoretical Organic Chemistry. (3) Molecular orbital treatment of structure and reactivity of organic molecules with emphasis on the applications of MO theory in pericyclic and photochemical reactions.

833. Advanced Reaction Mechanisms. (3) Detailed analysis of mechanisms with emphasis on characterization of transition state structure.

834. Chemical Equilibria and Related Topics. (3) Theory of electrolytic solution equilibria as applied to chemical analysis and review of statistical treatment of data.

835. Advances in Analytical Chemistry—Thermal Analysis. (3) Theory, principles, and selected applications of thermal methods of analysis, including thermogravimetry, thermometric titrations, and differential scanning calorimetry.

836. Advances in Analytical Chemistry—Physical Methods of Measurements. (3) Theory, principles, and analytical applications of selected physical measurements, including determination of molecular weight distributions and reaction rate methods in chemical analysis.

837. Advances in Analytical Chemistry—Lasers in Chemistry. (3) Introduction and investigation of the link between chemistry and lasers. Topics include modes of laser operation, laser-based probes, and laser-induced chemical change.

838. Advances in Analytical Chemistry—Luminescence Spectroscopy. (3) Instrumentation, methods, and applications of molecular luminescence spectroscopy.

839. Tutorial in Analytical Chemistry. (2 or 3)

843. Tutorial in Advanced Kinetics. (3)

844. Tutorial in Thermodynamics/Statistical Mechanics. (3)

848. Lasers in Physical Chemistry. (3) Survey of lasers and their use to study physical-chemical processes. Topics include types of lasers, range of spectral and temporal operation, methods of detection, and application to specific chemical problems.

849. Tutorial in Chiral Asymmetry in Chemistry and Physics. (3) Chiral asymmetry in nuclear, atomic, and molecular interactions. General group theoretic approach to spontaneous chiral symmetry breaking and the study of specific mechanisms.

860. Analytical Electrochemistry. (3) Applications to the identification and quantification of chemical compounds.

861. Applications of Electrochemistry. (3) Determination of inorganic and organic reaction mechanisms, electrochemical synthesis, applications to materials science.

862. Special Topics in Coordination Chemistry. (3) Selected applications of transition metal chemistry such as in paramagnetic resonance (NMR, EPR), bioinorganic chemistry, and industrial processes.

863. Crystallography. (3) Crystal structure determination using powder and single crystal X-ray diffraction.

864. Modern Chemical Spectroscopy. (3) Applications of vibrational, rotational, electronic, and nuclear spectroscopy to current problems in chemistry.

865. Metallopharmaceuticals. (3) Design and mechanism of metal-containing pharmaceuticals in cancer therapy and diagnosis.

869. Tutorial in Inorganic Chemistry. (3)

871. Advanced Quantum Chemistry. (3) Advanced quantum mechanical methods for the investigation of electronic structure and radiation-molecule interaction.

879. Tutorials in Theoretical Chemistry. (3)

891, 892. Dissertation Research. (1-9, 1-9)

Clinical and Population Translational Sciences (CPTS)

Bowman Gray Campus

Division Director Gregory L. Burke

Professors Walter Ambrosius, Nancy E. Avis, Bettina M. Beech, Ronny A. Bell, Gregory L. Burke, Robert P. Byington, L. Douglas Case, John R. Crouse III, Ralph B. D'Agostino Jr.

Mark A. Espeland, Curt D. Furberg, David C. Goff Jr., Mark A. Hall, Kim Hansen, David Herrington, William G. Hundley, Edward Ip, Claudine Legault, Michael E. Miller, Timothy M. Morgan, Michelle J. Naughton, Barbara Nicklas, Michael O'Shea, Sara A. Quandt, Steve Rapp, Beth A. Reboussin, David M. Reboussin, Sally A. Shumaker, Beverly Snively, John Spangler, Lynne E. Wagenknecht, Jeff Williamson, Mark Wolfson, Jianfeng Xu

Associate Professors Alain G. Bertoni, Laura H. Coker, Douglas Easterling, Ann Geiger, Fang-Chi Hsu, Carl Langefeld, Yongmei Liu, Mary Claire O'Brien, Scott Rhodes, Janet Tooze, Mara Vitolins

Assistant Professors G. Haiying Chen, Gregory Evans, Capri Foy, Denise K. Houston, Ann Lambros, Wei Lang, Iris Leng, Joseph A. Skelton, Erin Sutfin, Kathryn Weaver

The master of science degree in Clinical and Population Translational Sciences is administered through the Division of Public Health Sciences and the Translational Science Institute. The CPTS Program is open to individuals who already hold or are pursuing advanced degrees, such as the MD, DVM, ScD, PhD, DDS, DSN, MMS (Physician Assistant), or MSN who are seeking training in the clinical and population aspects of translational research. The program also may be appropriate for qualified applicants with at least a BA or BS in a social science, public health, or other health-related field, although additional post-baccalaureate coursework may be required. For applicants without an advanced degree, previous experience in a health-related field is required.

The purpose of this program is to assist students in developing competencies (theoretical/conceptual, methodology, statistics) required for the conduct of clinical and population research and the translation

of knowledge gained from such research into improved human health. Developing translational research skills is vital for the future success of researchers in the basic science and health professions. Translational research includes two areas of translation. One is the process of applying discoveries generated during laboratory research, and in preclinical studies, to the development of trials and studies in humans. The second area of translation concerns research aimed at enhancing the adoption of best practices in health care settings and the community. This program focuses on clinical research and the second area of translational research described above. (Of note, the graduate program in Molecular Medicine focuses on the first area of translation described above.)

Clinical and population research comprises studies and trials in human subjects including:

1. Patient-oriented research. Research conducted with human subjects (or on material of human origin such as tissues, specimens and cognitive phenomena) for which an investigator (or colleague) directly interacts with human subjects;
2. Epidemiologic and behavioral studies; and
3. Outcomes research and health services research.

While a minimum of twelve months of full-time work or its equivalent in residence is required for the master's degree, this program normally requires two years. In addition to coursework, all students complete a thesis project under the direction of a thesis committee. Students may initiate original data collection or analyze existing data sets. It is feasible to extend the program from two to three years. Students may matriculate only at the beginning of the fall semester each year.

The master of science degree in clinical and population translation science was initiated in the fall of 2008. It is one of a small number of similarly structured master's degree programs in the U.S., placing it on the cutting edge of graduate education.

703. Ethics and Responsibility in Clinical and Population Translational Science I. (1) Provides students with an overview of topics related to ethics and the responsible conduct of human subjects research. Students utilize a case-based format to address such topics as: study oversight and research design, informed consent, selection of subjects, conflicts of interest, the social effects of research, the use of embryos, fetuses and children in research, genetic research, and authorship and publication of study findings. Students are required to complete the Collaborative Institutional Training Initiative (CITI) Human Research On-Line Curriculum as part of this course. P—POI.

704. Ethics and Responsibility in Clinical and Population Translational Science II. (1) Provides students with an overview of topics related to ethics and the responsible conduct of human subjects research. Students utilize a case-based format to address such topics as: study oversight and research design, informed consent, selection of subjects, conflicts of interest, the social effects of research, the use of embryos, fetuses and children in research, genetic research, and authorship and publication of study findings. Students are required to complete the Collaborative Institutional Training Initiative (CITI) Human Research On-Line Curriculum as part of this course. P—CPTS 703 or POI.

705. Team Science Practicum in Clinical Translational Science. (3) Provides students with practical hands-on experience working on a collaborative, multidisciplinary translational study. Students from the molecular medicine and the clinical and population translational science programs work together in teams assigned to ongoing projects in the Translational Science Institute. Students become familiar with the study protocol and procedures, including mechanisms for protection of animals or human subjects.

Students participate in study conduct, review and interpretation of study data, and prepare a written report and oral presentation describing the practicum experience. P—POI.

720. Epidemiology. (4) Provides students with a foundation in the history, concepts, and methods of epidemiology. Topics include measurement of exposure to disease, prevalence, incidence, association, and sensitivity/specificity analyses. Measurement error, bias, confounding, effect modification, causality, and policy implications are discussed. The following observational study designs are reviewed: cross-sectional, cohort, ecological, and meta-analysis. Includes a weekly 1h problem solving laboratory. P—POI.

726. Genetic Epidemiology. (3) Presents fundamental concepts and methods in genetic epidemiology. Introduces various genetic epidemiology study designs in related and unrelated individuals and covers basic analysis, inferences, plus their strengths, and limitations. P—CPTS 720 and 730; BICM 731, or POI.

730. Introduction to Statistics. (4) Introduction to statistical concepts and basic methodologies that are prevalent in biomedical literature. Includes discussion topics such as: descriptive statistics, probability, sampling distributions, hypothesis testing, simple linear regression, correlation, one-way analysis of variance, categorical data analysis, survival analysis, sample size and power analysis, and nonparametric methods. P—POI.

732. Applied Linear Models. (4) Includes statistical concepts and basic methodologies related to the general linear model and its extensions. The basic statistical procedures discussed in the course include: simple and multiple linear regression, analysis of variance and covariance, logistical regression, and repeated measures analysis. Emphasis is given to proper application and interpretation of statistical methods and results. P—CPTS 730 or POI.

741. Research Grant Preparation. (3) Provides students with the knowledge and skills to develop grant proposals to pursue funding in their areas of interest. Topics covered include: the role of external funding in biomedical research; how to identify public and private sources of funding; required components of grant submission; and human subjects and budgeting considerations. Students develop a research proposal for peer review and critical discussion. P—POI.

742. Clinical Trial Methods. (3) Provides students with knowledge of clinical trials methodology from Phase I through Phase IV and beyond. Topics include: why trials are needed; specification of the trial question(s); basic trial designs; identification of the appropriate study population, interventions, and response variables; the randomization process; masking; sample size; data analysis; recruitment/retention/adherence; trial monitoring and interim analyses; assessing/reporting adverse effects; interpreting trial results; meta-analyses; and post marketing surveillance. P—POI.

747. Topics in Cancer Survivorship Research. (1) Provides students with an overview of topics related to cancer survivorship. Topics include: epidemiology of cancer survivorship, quality of life issues, cancer and the family, disparities in morbidity and mortality, late effects of cancer treatment, ethical issues, complementary and alternative medicine, symptom management, behavioral and lifestyle issues post-treatment, health services research, and special populations. Course may be repeated for credit. P—POI.

748. Conceptual Foundations of Community and Health Services Research. (2) Successful translation of research into practice takes place in community and health delivery settings, which present unique opportunities and challenges to translational scientists. After an introduction to research in these settings, the course focuses on the development of integrated aims, literature reviews, and conceptual frameworks that provide the necessary foundation for successful community and health delivery translational research. To provide students with the opportunity to expand their ability to develop and communicate research concepts, the course will include numerous in-class activities and several writing assignments.

749. Research Design and Measurement Methods for Community and Health Services Research. (4) The opportunities and challenges of translational research in community and health delivery settings require scientists to make informed, strategic choices regarding study designs and methods that ensure their research questions are answered appropriately. After beginning with an introduction to study designs unique to these settings, the course explores how designs are selected and examines specific application of these designs within the community and health delivery settings. The latter part of the course focuses on measurement, with emphasis on the development of data collection forms and surveys. To provide students with the opportunity to expand their ability to develop and communicate research concepts, the course includes in-class activities plus a presentation and writing assignments.

760. Topics in Clinical and Population Translational Sciences. (1-6) Seminar and/or lecture course on selected topics of current interest in clinical and population translational sciences not currently covered in the same depth in other courses.

766. Individual Study in Clinical and Population Translational Science. (1-4) Provides students with opportunities to pursue advanced topics in their individual areas of interest with guidance from expert faculty. May be repeated for credit. P—POI.

Communication (COM)

Reynolda Campus

Chair Ananda Mitra

University Distinguished Professor of Communication Ethics

and Professor of Communication Michael J. Hyde

Professors Sandra Dixon, Michael David Hazen, Candyce Leonard, Allan Loudon (Dir. of Graduate Studies), Ananda Mitra, Randall G. Rogan

Associate Professors Mary Dalton, Steven Giles, Marina Krcmar, John Llewellyn, Margaret D. Zulick

Assistant Professors Jarrod Atchison, Alessandra Beasley Von Burg

Lecturer Cindy Hill, Dee Oseroff-Varnell, Cara Pilsen

Part-time Professor Candyce Leonard

The Department of Communication offers graduate study leading to the MA degree. Students who enroll for the master's degree are expected to have a strong undergraduate background in the discipline in related areas and/or rationale for graduate work in communication. Deficiencies in undergraduate training may be required to complete undergraduate requirements at the University while studying for the degree. Most students will require two academic years to complete the program. The graduate program is associated with the Bioethic and Documentary Film graduate programs. Students have the opportunity to take classes in those areas as well. The program began in 1969.

Thesis Option

The minimum requirement is 33 semester hours of work, six of which are allotted for the thesis. The program requires a core of courses in research methodology and then allows students to take courses in context areas such as health communication, intercultural communication, interpersonal communication, mass communication, organizational communication, and public communication. In addition, the department provides work in communication ethics, communication technologies, and argumentation.

A program of study should include 6 hours of thesis work and a minimum of 27 hours of coursework, of which 6 hours may be in electives outside the department. Credits for up to 6 hours of graduate work can be transferred from another institution.

All students must demonstrate competence in a research skill relevant to their thesis and/or professional goals. Most students demonstrate their competency in empirical methodology or critical methodology; however, a foreign language also may be elected.

Comprehensive Examination Option

Students are required to complete 33 semester hours of coursework. At least 24 of the 33 hours required for the degree must be in courses numbered 700 or above. The remaining 9 hours may be in either 600-level or 700-level courses. A program of study can include 6 hours of coursework in electives outside the department. This includes credit for as many as 6 hours of graduate work transferred from another institution. Students will be required to successfully complete a comprehensive examination at the end of completing the 33 hours of coursework. Students are required to indicate their desire to take a comprehensive examination by the end of the first year of graduate work.

600. Classical Rhetoric. (3) Study of major writings in Greek and Roman rhetorical theory from the Sophists to Augustine. Offered in alternate years.

601. Semantics and Language in Communication. (3) Study of how meaning is created by sign processes. Among the topics studied are language theory, semiotics, speech act theory, and pragmatics.

602. Argumentation Theory. (3) Examination of argumentation theory and criticism; emphasis on both theoretical issues and social practices. Offered in alternate years.

604. Freedom of Speech. (3) Examination of the philosophical and historical traditions, significant cases, and contemporary controversies concerning freedom of expression. Offered in alternate years.

605. Communication and Ethics. (3) A study of the role of communication in ethical controversies.

606. Burke & Bakhtin Seminar. (3) Examines the language theories of Kenneth Burke and Mikhail Bakhtin in relation to contemporary rhetorical theory.

610. Advanced Media Production. (3) Special projects in audio and video production for students with previous media production experience. P—POI.

611. Film Theory and Criticism. (3) Study of film aesthetics through an analysis of the work of selected filmmakers and film critics. P—POI.

612. Film History to 1945. (3) Survey of the developments of motion pictures to 1945. Includes lectures, readings, reports, and screenings.

613. Film History since 1945. (3) Survey of the development of motion pictures from 1946 to present day. Includes lectures, readings, reports, and screenings.

614. Mass Communication Theory. (3) Theoretical approaches to the role of communication in reaching mass audiences and its relationship to other levels of communication.

615. Communication and Technology. (3) Exploration of how communication technologies influence the social, political, and organizational practices of everyday life.

- 616. Screenwriting.** (3) Introduction to narrative theory as well as examination of the role of the screenwriter in the motion picture industry, the influence of genre on screenwriting, and exploration of nontraditional narrative structures. Students complete and original, feature-length screenplay.
- 617. Communication and Popular Culture.** (3) Explores the relationship between contemporary media and popular culture from a cultural studies perspective using examples from media texts.
- 619. Media Ethics.** (3) Examines historical and contemporary ethical issues in the media professions within the context of selected major ethical theories while covering, among other areas, issues relevant to: journalism, advertising, public relations, filmmaking, and media management.
- 630. Communication and Conflict.** (3) Review of the various theoretical perspectives on conflict and negotiation as well as methods for managing relational conflict.
- 635. Survey of Organizational Communication.** (3) Overview of the role of communication in constituting and maintaining the pattern of activities that sustain the modern organization.
- 636. Organizational Rhetoric.** (3) Explores the persuasive nature of organizational messages—those exchanged between organizational members and those presented on behalf of the organization as a whole. Offered in alternate years.
- 637. Rhetoric of Institutions.** (3) A study of the communication practices of institutions as they seek to gain and maintain social legitimacy. Offered in alternate years.
- 638. 20th-Century African-American Rhetoric.** (3) Explores how African Americans have invented a public voice in the 20th century. Focuses on how artistic cultural expression, in particular, has shaped black public speech.
- 639. Practices of Citizenship.** (3) Explores the history and theory of citizenship as a deliberative practice linked to the rhetorical tradition of communication with an emphasis on participatory and deliberative skills as part of the process in which communities are formed and citizens emerge as members.
- 640. American Rhetorical Movements to 1900.** (3) Examines the interrelation of American rhetorical movements through the 19th century by reading and analyzing original speeches and documents, with emphasis on antislavery and women's rights.
- 641. American Rhetorical Movements since 1900.** (3) Examines the interrelation of American rhetorical movements in the 20th century by reading and analyzing original speeches and documents. Among the movements addressed are labor, civil rights, student radicals, and women's liberation.
- 642. Political Communication.** (3) Study of electoral communication including candidate and media influences on campaign speeches, debates, and advertising. Offered in alternate years.
- 643. Presidential Rhetoric.** (3) Examines theory and practice of speechmaking and mediated presidential communication. *Offered in alternate years.*
- 650. Intercultural Communication.** (3) Introduction to the study of communication phenomena between individuals and groups with different cultural backgrounds. Offered in alternate years.
- 651. Comparative Communication.** (1.5, 3) Comparison of communicative and rhetorical processes in the U.S. with one or more other national cultures with an emphasis on both historical and contemporary phenomena. a) Japan; b) Russia; c) Great Britain; d) Multiple countries. Offered in alternate years.

- 654. International Communication.** (3) In-depth look at the role of mass media in shaping communication between and about cultures using examples from traditional and emerging media systems.
- 655. Health Communication.** (3) Examination of theories, research, and processes of health communication in contemporary society.
- 670. Special Topics.** (1-4) Examination of topics not covered in the regular curriculum.
- 680. Great Teachers.** (3) Intensive study of the ideas of three noted scholars and teachers in the field of communication. Students interact with visiting scholars during visits to Wake Forest.
- 719. Theory and Research Design in Communication Science.** (3) Examination of communication science theory with a focus on critiquing and utilizing theory in research, accompanied by an overview of quantitative research design and methodology.
- 720. Quantitative Analysis in Communication Science.** (3) Overview of statistical data analysis, interpretation, and reporting for communication research. P—COM 719.
- 753. Seminar in Persuasion.** (3) Study of contemporary social science approaches to persuasion theory and research. Influence is examined with interpersonal, social, and mass media contexts.
- 758. Rhetorical Theory.** (3) Introduction to primary texts in the theory of rhetoric including classical theories, dramatism, semiotics, and critical/cultural studies.
- 759. Rhetorical Criticism.** (3) The critical application of rhetorical theories aligning with the traditions covered in Communications 758. P—COM 758.
- 763, 764. Proseminar in Communication.** (1.5, 1.5) Introduction to graduate study in communication.
- 773. Seminar in Interpersonal Communication.** (3) Study of recent research and theoretical developments in dyadic communication. Methodology examined includes conversational analysis, field, and experimental approaches.
- 774. Research and Theory of Organizational Communication.** (3) Advanced study of theoretical approaches to the role of communication in organizations and empirical application of such theories.
- 780. Special Seminar.** (1-3) Intensive study of selected topics in communication. Topics may be drawn from any theory or content area of communication and offer a wide variety of special topics across a two year program
- 781, 782. Readings and Research in Speech Communication.** (1-3, 1-3) Students may receive credit for a special reading project in an area not covered by regular courses or for a special research project not related to the master's thesis.
- 791, 792. Thesis Research.** (1-9)

Comparative Medicine (COMD)

Bowman Gray Campus, Friedberg Campus

Pathology (Section on Comparative Medicine)

Section Head Jay R. Kaplan

Professors Thomas B. Clarkson Jr., J. Mark Cline, Randolph L. Geary, Jay R. Kaplan, Nancy D. Kock, Carol A. Shively, Janice D. Wagner, J. Koudy Williams

Associate Professors Thomas C. Register, Richard W. Young

Assistant Professors Susan E. Appt, Matthew J. Jorgensen, Kylie Kavanagh, Cynthia J. Lees

Instructor Melaney K. Gee

Associate Faculty Mary Lou Voytko

The section on comparative medicine in the Department of Pathology offers a program leading to the MS degree in Comparative Medicine for individuals with a professional degree (DVM or MD). The MS degree has been offered since 1964.

Research is an important facet of departmental activities, and research training is emphasized in its educational programs. Investigative efforts focus on animals as models of human disease and the use of animals in biomedical research. Major interests include cardiovascular disease (especially atherosclerosis), cancer biology and risk assessment, diabetes and obesity, behavioral biology such as depression and anxiety, women's health/reproductive medicine, nutrition, comparative pathology, and substance abuse.

There is an active interest in the biology and diseases of nonhuman primates as translational surrogates for the study of human diseases. A colony of approximately 1,000 nonhuman primates of several species is maintained to provide ample material for students interested in nonhuman primate biology. In addition, specialized colonies of rodents and other species are also used in conjunction with other biomedical research programs at Wake Forest University.

703. Diseases of Laboratory Animals. (3) Naturally occurring diseases of laboratory animals are considered in depth. Lectures are organized by animal species and are designed to emphasize the prevalence and physiological and pathological expression of both infectious and metabolic/degenerative diseases. Additional emphasis is on the diagnosis and management of these diseases in the laboratory animal facility. Special topics, including disease surveillance, zoonoses, and strain differences in disease susceptibility, are also presented. Offered in odd-numbered years. P—DVM or MD degree or POI.

706. Animal Models in Biomedical Research. (3) Designed to provide the student with the current knowledge about animal models used in biomedical research. The major disease problems of man are discussed by organ system. For each disease problem, the advantages and disadvantages of animal models in current use are discussed. Both experimentally induced and naturally occurring diseases of animals are considered. Offered in even-numbered years. P—POI.

708. Medical Primatology. (3) Acquaints the student with the biology, laboratory management, behavior, and diseases of the nonhuman primates of biomedical interest. Emphasis is on both: a) the clinical manifestations, diagnosis, and management of diseases that are the principal causes of morbidity and mortality in laboratory primates; and b) those aspects of social structure and colony management that contribute to susceptibility and resistance to such diseases. Course considers issues relating to the psychological well-being of laboratory primates. Offered in even-numbered years. P—POI.

709, 710. Advanced Topics in Comparative Medicine. (Credit to be arranged, 1-5) An advanced lecture and student participation course dealing with areas of new knowledge in comparative medicine. P—General biochemistry, general pathology, or equivalents.

711, 712. Comparative Pathology Conference. (1, 1) Necropsy cases are presented and discussed by postdoctoral fellows and staff. Management of current medical problems and the comparative aspects of the materials presented are emphasized.

713, 714. Research. Research in a variety of topics in comparative medicine, including research in preparation for the master's thesis and the doctoral dissertation.

Computer Science (CSC)

Reynolda Campus

Chair Stan J. Thomas

Reynolds Professors Jacquelyn S. Fetrow, Robert J. Plemmons

Professors Jennifer J. Burg, David J. John

Associate Professors Daniel A. Cañas, Errin W. Fulp, V. Paúl Pauca,
Stan J. Thomas, Todd C. Torgersen

Assistant Professor Samuel S. Cho, William H. Turkett Jr.

Adjunct Assistant Professor Timothy E. Miller

The department offers a program of study leading to the master of science degree in computer science. The program is designed to accommodate students seeking either a terminal master's degree or preparation for PhD work at another institution.

The Master of Science in Computer Science

In addition to the graduate school admission requirements, students entering the graduate program must have completed computer science coursework in the areas of: 1) programming in a modern high-level language, 2) basic computer organization and architecture, 3) data structures, and 4) principles of operating systems and networks. Students should also have completed mathematics courses equivalent to: 1) differential and integral calculus including infinite series, 2) discrete mathematics, 3) linear algebra, and 4) probability and statistics.

The requirements for the Master's of Science degree may be met in one of three ways. The courses CSC 631, 641, 702, and 721 are identified as the core courses for the MS degree and are required of all students.

The MS degree with thesis requires 30 semester hours including 6 hours of thesis research (CSC 791, 792) and a successfully completed thesis. The coursework must include the twelve-hour core. The remaining twelve hours are selected from computer science courses with at least six of these hours from 700-level courses other than CSC 795.

The MS degree with project requires thirty-three semester hours including three hours of project research (CSC 795) and a successfully completed project. The coursework must include the twelve-hour core. The remaining eighteen hours are selected from computer science courses with at least six of these hours from 700-level courses other than CSC 791, 792.

For the MS degree without thesis or project, 36 semester hours are required. The coursework must include the 12-hour core. The remaining hours are selected from computer science courses with at least 6 of these hours from 700-level courses other than CSC 791, 792 and 795.

With the approval of the graduate adviser, graduate courses may be taken in related areas to fulfill requirements; however, no more than 6 such hours may count toward the degree.

Computer science graduate students can apply to participate in the Interdisciplinary Graduate Track in Structural and Computational Biophysics. The specific requirements are found in this bulletin under the courses of instruction. On successful completion of this Track a student will earn an MS degree in computer science (thesis option) with a Certification in Structural and Computational Biophysics.

The Master's of Science program in computer science began in 1991. Current information on the program and links to faculty interests can be accessed on the Web at www.cs.wfu.edu.

Computing Resources

The department supports UNIX-based workstations, file servers, and personal computers in a local area network, with high-speed access to the Internet. Access is also available to the University's parallel computing systems for high performance computation.

611. Computer Architecture. (3) In-depth study of computer systems and architectural design. Topics include processor design, memory hierarchy, external storage devices, interface design, and parallel architectures.

621. Database Management Systems. (3) Introduction to large-scale database management systems. Topics include data independence, database models, query languages, security, integrity, and concurrency.

631. Object-oriented Software Engineering. (3) Study of software design and implementation from an object-oriented perspective, covering abstraction, encapsulation, data protection, inheritance, composition, polymorphism and dynamic versus static binding. Students practice software engineering principles through team projects.

633. Principles of Compiler Design. (3) Study of techniques for compiling computer languages including scanning, parsing, translating, and generating code.

641. Operating Systems. (3) Study of the different modules that compose a modern operating system. In-depth study of concurrency, processor management, memory management, file management, and security.

643. Internet Protocols. (3) Study of wide area connectivity through interconnection networks. Emphasis is on Internet architecture and protocols. Topics include addressing, routing, multicasting, quality of service, and network security.

646. Parallel Computation. (3) Study of hardware and software issues in parallel computing. Topics include a comparison of parallel architectures and network topologies, and an introduction to parallel algorithms, languages, programming, and applications.

648. Computer Security. (3) Introduction to computer security concepts and associated theory. Detailed coverage of the core concepts of access control, cryptography, trusted computing bases, digital signatures, authentication, network security, and secure architectures. Legal issues, security policies, risk management, certification and accreditation are covered in their supporting roles. Students will learn to analyze, design, and build secure systems of moderate complexity.

652. Numerical Linear Algebra. (3) Numerical methods for solving matrix and related problems in science and engineering. Topics include systems of linear equations, least squares methods, and eigenvalue computations. Beginning knowledge of a high-level programming language is required. Credit not allowed for both CSC 652 and MTH 626.

655. Introduction to Numerical Methods. (3) Numerical computations on modern computer architectures; floating-point arithmetic and round-off error. Programming in a scientific/engineering language such as MATLAB, C, or FORTRAN. Algorithms and computer techniques for the solution of problems such as roots of functions, approximation, integration, systems of linear equations, and least squares methods. Credit not allowed for both MTH 655 and CSC 655.

661. Digital Media. (3) Introduction to digital media covering sampling and quantization, resolution, color representation, multimedia file formats, data encoding and compression, multimedia network issues, streaming data, and multimedia programming.

663. Computer Graphics. (3) Study of software and hardware techniques in computer graphics. Topics include line and polygon drawing, hidden line and surface techniques, transformations, and ray tracing.

665. Image Processing Fundamentals. (3) Study of the basic theory and algorithms for image enhancement, restoration, segmentation, and analysis.

671. Artificial Intelligence. (3) Introduction to problems in artificial intelligence. Knowledge representation and heuristic search in areas such as planning, machine learning, pattern recognition, and theorem proving.

685. Bioinformatics. (3) Introduces bioinformatics and computing techniques essential to current biomedical research. Topics may include genome and protein sequence and protein structure databases, algorithms for sequence and structure analysis, and computer architecture and environment considerations. Emphasizes interdisciplinary interaction and communication and includes a project that may use software engineering and project management protocols and require working as part of an interdisciplinary team. Also listed as PHY 685.

687. Computational Systems Biology. (3) Introduction of concepts and development of skills necessary for comprehension of modern systems biology research problems, including both biological and computational aspects. Topics may include microarrays, protein interaction networks, large-scale proteomics experiments, and algorithms and computational approaches for modeling, storing, and analyzing the resulting data sets. Emphasizes interdisciplinary interaction and communication and includes a project that may use software engineering and project management protocols and require working as part of an interdisciplinary team.

691. Selected Topics. (1, 2, 3) Topics in computer science which are not studied in regular courses or which further examine topics begun in regular courses. P—POI.

693. Individual Study. (1 or 2) Independent study directed by a faculty adviser. By prearrangement.

702. Theory of Computation. (3) Basic theoretical principles of computer science. Topics include the relationship between automata and grammars, Church's thesis, unsolvability, and computational complexity.

721. Theory of Algorithms. (3) Design and analysis of algorithms. Topics may include time and space complexity analysis, divide-and-conquer algorithms, the fast Fourier transform, NP-complete problems, and efficient algorithms for operations on lists, trees, graphs, and matrices.

726. Parallel Algorithms. (3) A thorough, current treatment of parallel processing and supercomputing. Modern high-performance commercial architectures, parallel programming, and various supercomputing applications are discussed. Hands-on experience is emphasized. Students are given access to a variety of machines.

731. Compiler Optimization. (3) Design and implementation of optimizing compilers. Optimization techniques, parallelizing transforms, and comparative examples from the literature. P—CSC 633.

743. Topics in Operating Systems. (3) Issues in operating system development; resource management, queuing theory, concurrent processing, and languages for operating system development. P—CSC 641.

753. Nonlinear Optimization. (3) The problem of finding global minimums of functions is addressed in the context of problems in which many local minima exist. Numerical techniques are emphasized, including gradient descent and quasi-Newton methods. Current literature is examined and a comparison made of various techniques for both unconstrained and constrained optimization problems. Credit not allowed for both MTH 753 and CSC 753. P—CSC or MTH 655.

754. Numerical Methods for Partial Differential Equations. (3) Numerical techniques for solving partial differential equations (including elliptic, parabolic and hyperbolic) are studied along with applications to science and engineering. Theoretical foundations are described and emphasis is on algorithm design and implementation using either C, FORTRAN or MATLAB. Also listed as MTH 754. P—CSC 655 or MTH 655.

765. Image Processing. (3) Advanced techniques in image processing including image formation and corruption models, digitization, Fourier domain methods, enhancement, restoration, and tomographic reconstruction. P—CSC 721.

766. Pattern Recognition. (3) Study of statistical pattern recognition techniques and computer-based methods for decision-making, including discriminant functions, feature extraction, and classification strategies. Emphasis is on applications to medical image analysis. P—POI.

767. Computer Vision. (3) Techniques for extracting features from images: optimal thresholding, 2D and 3D feature measurement, graph isomorphism and graph matching methods. P—CSC 766.

775. Neural Networks. (3) Design of artificial neural networks. Introduction to the relevant neurophysiology, feedforward networks, recurrent networks, and applications to pattern recognition and optimization.

779. Topics in Artificial Intelligence. (3) Advanced topics in artificial intelligence. Individual projects are assigned. P—CSC 671.

781. Computer Science Seminar. (0) Discussions of contemporary research. No credit.

790. Advanced Topics in Computer Science. (3) Advanced topics of current interest in computer science not covered by existing courses. P—POI.

791, 792. Thesis Research. (1-9)

795. Project. (3)

Counseling (CNS)

Reynolda Campus

Chair Samuel T. Gladding

Professors Samuel T. Gladding, Donna A. Henderson

Associate Professor Debbie W. Newsome, Jose A. Villalba

Assistant Professor Philip B. Clarke

The master of arts in counseling degree is awarded to candidates who successfully complete a minimum of sixty semester hours in a planned and directed program of study. The program consists of a common core of courses to provide knowledge in eight areas: human growth and development, social and cultural foundations, helping relationships, group work, career and lifestyle development, appraisal, research and program evaluation, and professional orientation. The program also supplies clinical instruction with practicum and internship experiences. In addition, students must select a program specialty area—school counseling or clinical mental health counseling—in which they complete their internships and take courses that assure at least entry-level competence.

School Counseling Program. The School Counseling Program is designed to provide prospective school counselors with the knowledge, skills, and competence necessary to establish and conduct effective developmental guidance and counseling programs in schools, kindergarten through the twelfth grade. The course of study that leads to a license in school counseling in North Carolina (and through reciprocity agreements leads to licensure in most other states), is based on the requirements of the North Carolina State Board of Education, and is accredited by the National Council for Accreditation of Teacher Education, and the Council on Accreditation of Counseling and Related Educational Programs (CACREP).

Clinical Mental Health Counseling Program. In the Clinical Mental Health Counseling Program, students are prepared for counseling in a wide variety of community settings and agencies. The course of study is accredited by the Council on Accreditation of Counseling and Related Educational Programs.

Admission to the Program. Admissions decisions are based on consideration of a combination of criteria: college grade-point average, Graduate Record Examination scores, recommendations, professional commitment, work or volunteer experience in the human services field, and suitability for the profession. Applicants being considered for admission are required to have a personal interview with program faculty. Candidates for the counseling programs are not required to have a specific undergraduate major or minor.

Continuance in the program and admission to candidacy are based on success in academic courses and on personal, ethical, and performance considerations.

Graduates are eligible to sit for the National Certified Counselor examination. Those who complete the School Counseling Program are eligible to apply for licensure with the Public Schools of North Carolina.

All courses listed are open to counseling students only unless otherwise noted.

721. Research Analysis in Counseling. (3) Qualitative and quantitative research methods. Analysis and evidence-based evaluation of research-based literature in the counseling field. Grant writing. Program evaluation. Descriptive, inferential, parametric and non-parametric statistical procedures involved in research.

723. Statistical Analysis for the Helping Professions. (3) Descriptive, inferential, and non-parametric statistical procedures involved in research. Computer methods for statistical analysis.

736. Appraisal Procedures for Counselors. (3) Appraisal, assessment, and diagnosis of personality, emotional, intellectual, and learning characteristics and disorders of clients in schools, colleges, and community human service agencies. Use of tests in counseling as an adjunct to clinical impressions.

737. Basic Counseling Skills and Techniques. (3) Basic communication skills, helping relationships, and strategies for personal change. Issues and ethics in counseling.

738. Counseling Practicum. (2-3) Supervised experience for the development of individual and group counseling skills under individual and group supervision in a school or community agency. Involvement in direct service work and activities similar to those of regularly employed professional staff. Individual and group supervision of practicum experiences. P—EDU 737.

a. School

b. Clinical mental health

739. Advanced Counseling Skills and Techniques. (2-3) Advanced and specialized counseling interventions including crisis intervention, suicide prevention, and emergency management methods. Demonstration of skill level required. P—CNS 737.

740. Professional Orientation to Counseling. (3) Covers the history, roles, organizational structures, ethics, standards, specializations, and credentialing in the profession of counseling. Public policy processes and contemporary issues are also considered.

741. Theories and Models of Counseling. (3) Study of theories and approaches to professional counseling: psychoanalytic (Freud, Adler, Jung), person-centered (Rogers), existential (May, Frankl), behavioral (Skinner, Glasser), cognitive/rational (Ellis), holistic/systemic, eclectic. Professional orientation, issues, ethics, cultural pluralism, and trends in counseling.

742. Group Procedures in Counseling. (3) An experiential and conceptual exploration of the psychological dynamics and interpersonal communication of small groups, including group structure, leadership models, group process and practice, stages of group development, group techniques, and ethical principles.

743. Career Development and Counseling. (3) Vocational development throughout life; psychological aspects of work; occupational structure and the classifications of occupational literature; theories of vocational choice and their implications for career counseling.

744. Counseling Internship I. (3) Supervised counseling experience in a school, college, or clinical mental health agency under a regularly employed staff member professionally trained in counseling and in supervision. Active participation in direct service work to clients. Monitoring of audio or videotaped interviews. Case review. P—CNS 738.

a. School

b. Clinical mental health

745. Counseling Internship II. (3) Supervised counseling experience in a school, college, or clinical mental health agency under a regularly employed staff member professionally trained in counseling and in supervision. Active participation in direct service work to clients. Monitoring of audio or videotaped interviews. Case review. P—CNS 744.

a. School

b. Clinical mental health

746. Counseling Children. (3) Theory and practice of counseling with children in schools and community agencies. Elementary school counseling; models, methods, and materials. Counseling children with special emotional, learning, psychological, or behavioral concerns.

747. Cultures and Counseling. (3) The influence of culture in human development and in counseling relationships. A study of personal and ethnic diversity and commonality.

748. Life Span Development: Implications for Counseling. (3) Examination of major theories and principles of human development across the life span, including physical, psychological, intellectual, social, and moral perspectives.

749. School Guidance and Counseling. (3) The organization and management of comprehensive school guidance and counseling programs. Individual and group counseling, consultation, coordination, and collaboration in student services in schools. Program development in elementary, middle, and secondary schools.

750. The Vienna Theorists—Freud, Adler, Moreno and Frankl. (3) Examination of the original writings of four of the leading theorists of modern counseling, which is enhanced by a visit to the city in which they initially formulated their clinical ideas. Students read and discuss several original writings of each practitioner—Freud, Adler, Moreno, and Frankl—prior to and during a two-week stay in the Wake Forest University Flow House in Vienna during which they visit relevant historical sites and institutes.

760. Issues in School Counseling. (3) Designed to allow students to investigate current issues related to the practice of school counseling. Emphasis is on identifying appropriate prevention responses to these issues.

762. Issues in Clinical Mental Health Counseling. (3) Examines specific issues related to clinical mental health counseling including, but not limited to, reimbursement, outcome evaluation, advocacy strategies, clinical mental health counselor roles and functions.

763. Specialized Study in Counseling. (1-3) Exploration of special topics or areas of practice in the field of counseling.

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| <i>a. School Guidance and Counseling</i> | <i>h. Rehabilitation</i> |
| <i>b. College Student Development Services</i> | <i>i. Adult Development/Aging Counseling</i> |
| <i>c. Mental Health Counseling</i> | <i>j. Religious Counseling</i> |
| <i>d. Marriage and Family Counseling</i> | <i>k. Health Counseling</i> |
| <i>e. Business/Industry Counseling</i> | <i>l. Multicultural Counseling</i> |
| <i>f. Correctional Counseling</i> | <i>m. Holistic Counseling</i> |
| <i>g. Career Counseling</i> | <i>n. Tests, Measurements and Interpretation</i> |

764. Creative Arts in Counseling. (1-3) Examines history, theories, processes, and techniques of using the creative arts in counseling with clients throughout the life span. Particular attention is given to the visual and verbal arts, such as drawing, imagery, photography, cartooning, cinema, movement, dance, literature, drama, and music.

765. Addiction Counseling. (3) Introduces the concepts of chemical dependency, counseling procedures and techniques, and treatment considerations. The student has opportunities to apply models of chemical dependency counseling to hypothetical situations at various stages of substance use.

770. Classification of Mental and Emotional Disorders. (3) Analyzes healthy and unhealthy personality, as well as developmental and situational problems in adjustment. Studies the classification of mental disorders, as defined by the American Psychiatric Association in the most recent edition of the Diagnostic and Statistical Manual of Mental Disorders. Examines appropriate ways in which diagnosis can be utilized by counselors to explore personality and systemic interventions for career, educational, and relationship concerns.

771. Clinical Mental Health Counseling. (3) History, philosophy, organization, management, and delivery of counseling services in various clinical mental health settings. Preventative, developmental, and remedial strategies for use with various populations.

772. Marriage and Family Systems. (3) Study of the institutions of marriage and the family from a general systems perspective. Exploration of how changes in developmental and situational aspects of the family life cycle influence individuals within the systems of marriage and the family. Both horizontal and vertical dimensions of change are focused on through the use of genograms. Different forms of family lifestyles, such as dual career, single parent, and blended are covered.

773. Family Counseling. (3) Examination of the philosophy and goals of seven major theories of family counseling (Bowenian, Adlerian, psychodynamic, experiential/humanistic, behavioral, structural, strategic) as well as the development of the profession of family counseling from an historical and current trends perspective. Differences between family counseling and individual/group counseling are highlighted and ethical/legal considerations for working with family units are stressed. Techniques associated with theories are demonstrated through video and play simulations. Research methods for gathering data on families are highlighted.

774. Marriage Counseling. (3) Study of the philosophy and goals of six main theories of marriage counseling (psychoanalytic, social learning, Bowenian, structural-strategic, experiential/humanistic, and rational-emotive) and the techniques associated with each. Historical and current trends associated with the field of marriage counseling are explored, along with related issues such as premarital counseling, family-of-origin influences within marriage, and widowhood. Appropriate marriage assessment instruments, research methods, and ethical/legal questions involved in marriage counseling are addressed.

775. Marital and Family Health and Dysfunctionality. (3) Examines system and individual dynamics associated with marital and family health and dysfunctionality. Longitudinal research on factors connected with healthy, long-term marriages and functional family life are explored. Interactive patterns that lead to such marital and family dysfunctionality as spouse and child abuse, anorexia nervosa, addictive disorders, and dependency are examined.

780. Professional, Ethical and Legal Issues in Counseling. (2) Provides an overview of the critical professional issues in counseling with emphasis on current ethical, legal, and values-related questions and the relationship of these issues to the counselor's role in training, supervision, consultation, appraisal, and research. P—Advanced graduate standing or permission of instructor.

782. Developmental Counseling Psychology. (3) Theoretical, research, and methodological aspects of a developmental/holistic/systems framework for counseling. Integration and application of major theories and approaches to counseling.

786. Consultation and Program Development in Counseling. (2) Consultation theory and process. Consultation with families, schools, colleges, and community agencies. Models for facilitating change in human systems.

790. Professional Identity Capstone Course. (1) Review and application of counseling skills, settings, practice parameters and other current issues necessary to integrate students into the profession of counseling. P—CNS 744

Documentary Film Program (DOC)

Reynolda Campus

Co-directors Mary Dalton, Sandra Dickson

Lecturers Cynthia Hill, Cara Pilson

The Documentary Film Program offers graduate study leading to the MA degree in documentary film through a two-year course of study and the MFA degree through a three-year course of study. The program admits students on a full-time basis only.

The MA requires 36 hours: 30 hours in required documentary courses such as research, theory, writing, direction, and production; and, 6 hours in creative thesis. All students follow the same course of study for the first two years, and MFA students continue for a third year. The MFA requires 54 hours and builds on the foundation of the first two years of study with the following: advanced work in a cognate area, a course in pedagogy and curriculum, an option to take a teaching practicum, and an advanced creative project.

While this is a skills intensive curriculum, it is also a plan of study that emphasizes the social awareness elements that lie at the heart of the documentary tradition. The faculty believes it is imperative to impart to students the power and responsibility documentary filmmakers have in a world increasingly dependent on the moving image as a way to educate, inform, and affect change.

701. Internship I. (1.5) Summer internships may be taken for 1.5 credits on a pass/fail basis when approved by faculty members. These internships provide students the opportunity for experiential learning at production houses, television networks, public television stations, and at other facilities deemed useful as well as with independent producers.

702. Internship II. (1.5) Summer internships may be taken for 1.5 credits on a pass/fail basis when approved by faculty members. These internships provide students the opportunity for experiential learning at production houses, television networks, public television stations, and at other facilities deemed useful as well as with independent producers.

711. Research Methods in Documentary.(3) Provides an understanding of the research process that precedes the production of a documentary and the skills needed to construct an effective research strategy. Students learn how to refine these strategies to meet the specific demands of various documentary genres.

713. Writing for Documentary. (3) Designed to familiarize students with the nature and purpose of documentary as well as the fundamentals of documentary writing, including drama, structure, story development, and style.

715. Documentary Field Production.(3) Through a combination of lectures, film screenings, and hands-on demonstrations, this course familiarizes students with the basics of documentary producing, shooting, lighting, sound gathering, and editing.

724. Advanced Documentary Field Production.(3) Designed to teach theoretical, aesthetic, and technical principles of non-linear editing for documentary. Principally, students are taught how to: digitize and organize source material, create basic effects and titles, develop sequences, and organize and edit raw materials into a polished final product. P—DOC 715

726. Documentary Pre-Production Planning.(3) Teaches students how to conceptualize and develop a documentary. The course is divided into four major components: the idea, funding, production planning, and proposal writing and presentation.

728. Documentary History. (3) Acquaints students with the historical development of documentary film from its roots in 19th-century art forms to the present. Examines various styles and techniques of documentary and analyzes the contribution of the documentary as a persuasive means of communication to achieve social and political goals. Open to all Wake Forest University graduate students with permission of instructor.

731. Producing, Directing, and Writing Documentary. (3) Students learn the fundamentals of producing, directing, and writing for documentary as well as the major business and aesthetic dimensions of documentary production.

733. Post Production Techniques.(3) Covers advanced technical, theoretical, aesthetic, and ethical principles of the post-production processes used in the editing of documentaries. Topics include developing continuity, building sequences, refining dramatic structure, selecting narrators, and incorporating music and sound effects to enhance documentary clarity and impact. Open to all Wake Forest University graduate students with permission of instructor.

735. Issues and Problems in Documentary. (3) Provides students with the opportunity to explore the ethical issues that can arise in documentary filmmaking. The discussion points will evolve from the in-depth examination of a select group of films and directors. Open to all Wake Forest University graduate students with permission of instructor.

746. Advanced Post Production Techniques. (3) Primarily geared toward handling issues related to the completion and distribution of the creative thesis project. P—DOC 733

748. Creative Thesis Project. (6) Students work under faculty supervision on a creative thesis project.

751. Pedagogy and Curriculum. (3) Provides an understanding of pedagogical practices and major theories of curriculum and provide a foundation for students interested in pursuing careers in academe. Open to all Wake Forest University graduate students with permission of instructor.

753. Individual Study. (1-3) For students who wish to perform independent study in a cognate area with a professor from the Documentary Film Program or another program.

764. Individual Study. (1-3) For students who wish to perform independent study in a cognate area with a professor from the Documentary Film Program or another program.

766. Teaching Practicum. (3) Students work closely with Documentary Film Program faculty during the teaching of an undergraduate course. Students participate in the design and development of course material and observe classroom and organizational aspects of teaching in an apprenticeship role.

768. Advanced Creative Project.(6) Students work under faculty supervision on an advanced creative project.

780. Master Class in Documentary Storytelling. (3) Project-based course designed to help students master advanced storytelling skills and develop business acumen, strategies, and distribution plans. P—DOC 711, 713, 715, 724, 726 and 728.

Education (EDU)

Reynolda Campus

Chair Mary Lynn Redmond

Professors Leah P. McCoy, Joseph O. Milner, Linda N. Nielsen, Mary Lynn Redmond

Associate Professors Ann Cunningham, Adam Friedman

The Department of Education offers professional graduate programs in teacher education. The goals and requirements for these programs are available in the Licensure Office of the department.

Master Teacher Fellows Program. This program is designed for a select group of students who have earned a baccalaureate degree with a major in biology, chemistry, English, French, history, mathematics, physics, social science, or Spanish. Students enter the program in the first week of June and in thirteen months earn the Master of Arts in Education and the teaching license.

Master Teacher Associates Program. This program is for candidates who have earned the initial license to teach at the secondary level or K-12 French and Spanish, have a record of strong teaching, and want to pursue graduate study. Students in this program earn the Master of Arts in Education and help supervise student teachers who are earning an initial license.

Visiting International Fellows Program. This program offers a Master of Arts in Education that is appropriate to the professional needs of the diverse group of excellent teachers from other nations who are teaching in American schools. The program can be completed in three summers.

Licensure Only Coursework. Students who wish to enroll in graduate courses to obtain or renew a license may seek admission through the Licensure Officer of the Department of Education. The GRE is not required.

A copy of the Title II Federal Report Card may be obtained in the Licensure Office of the department.

601. Microcomputer and Audiovisual Literacy. (3) Introduction to microcomputers for educators and other users, emphasizing familiarity with computers, use and evaluation of software, and elementary programming skills. Experience with audiovisual materials and techniques is included.

602. Production of Instructional Materials. (3) Methods of producing instructional materials and other technological techniques. P—EDU 601 and senior or graduate standing.

603. History of Western Education. (3) Educational theory and practice from ancient times through the modern period, including American education.

604. Theories of Education. (3) Contemporary proposals for educational theory and practice studies in the context of social issues.

605. The Sociology of Education. (3) Study of contemporary educational institutions. Examines such issues as school desegregation, schooling and social mobility, gender equity, and multiculturalism.

606. Studies in the History and Philosophy of Education. (3) Study of selected historical eras, influential thinkers, or crucial problems in education. Topics announced annually.

- 612. Teaching Children with Special Needs.** (3) Survey of the various types of learning problems commonly found in elementary children. Students observe exemplary programs, tutor children with special needs, and attend seminars on effective instructional techniques.
- 613. Human Growth and Development.** (3) Theories of childhood and adolescent development, their relation to empirical research, and their educational implications. Consideration of the relation to learning of physical, intellectual, emotional, social, and moral development in childhood and adolescence.
- 637. TESOL Linguistics.** (3) Introduction to the theoretical and practical linguistics resources and skills for teaching English to speakers of other languages (TESOL) within the U.S. or abroad. P—LIN/ANT 150, or ENG 304.
- 651. Adolescent Psychology.** (4) Introduction to theories of adolescent psychology as related to teaching and counseling in various settings. Readings emphasize researchers' suggestions for parenting, teaching, and counseling adolescents between the ages of 13 and 19.
- 654. Content Pedagogy.** (3) Methods, materials, and techniques used in teaching particular secondary subjects (English, mathematics, science, second languages, social studies).
- 654L. Content Pedagogy Rounds.** (2) Practical experiences in classrooms with focus on pedagogy and content. Weekly public school experience and seminar. Pass/fail only.
- 661. Foundations of Education.** (3) Philosophical, historical, and sociological foundations of education, including analysis of contemporary issues and problems.
- 664L. Student Teaching Internship.** (9) Supervised teaching experience in grades 9-12 (K-12 for foreign language). Full-time, 15-week field experience. Includes a weekly on-campus seminar. Pass/fail only.
- 665. Professional Development Seminars.** (3) Analysis and discussion of problems and issues in secondary school teaching. Examination of research and practice-based strategies. Pass/fail only.
- 674. Student Teaching Seminar.** (1.5) Analysis and discussion of practical problems and issues in the teaching of particular secondary subjects (English, mathematics, science, second languages, social studies). Emphasis is on the application of contemporary instructional methods and materials. Includes prior (intercession) 20 hours field experience requirement.
- 681. Special Needs Seminar.** (1) Analysis and discussion of practical problems and issues in the teaching of special needs students in the secondary classroom. Topics include classroom management, reading and writing in the content area, inclusion, and evaluation. *Pass/Fail only.*
- 682. Reading and Writing in the Content Areas.** (2) Survey of methods for teaching reading and writing to help students learn in the various content areas, and of techniques for adapting instruction to the literacy levels of students.
- 683. Classroom Management Seminar.** (1) Examination of research and practice-based strategies for secondary school classroom management and discipline *Pass/Fail only.*
- 684. Creative Research Methodologies.** (2) Investigation of source materials, printed and manuscript, and research methods which are applied to creative classroom experiences and the preparation of research papers in literature and social studies.
- 685. Diversity Seminar.** (1) Exploration of multi-cultural issues and relevant Spanish language and cultural teaching practices essential for classroom communication. *Pass/Fail only.*

- 687. Tutoring Basic Writing.** (2) Review of recent writing theory applicable to teaching basic writers (including the learning disabled and non-native speakers). Special attention to invention strategies and heuristic techniques. Includes experience with tutoring in the Writing Center. (Credit not allowed for both EDU 387 and ENG 387.)
- 690. Methods and Materials for Teaching Foreign Language (K-6).** (3) Survey of the basic materials, methods, and techniques of teaching foreign languages in the elementary and middle grades. Emphasis is on issues and problems involved in planning and implementing effective second language programs in grades K-6. *Spring only.*
- 693. Individual Study.** (3) A project in an area of study not otherwise available in the department; permitted upon departmental approval of petition presented by a qualified student.
- 695. Teaching Exceptional Students.** (3) Introduction to understanding exceptional students and the most effective teaching strategies for their inclusion in the regular classroom.
- 698. Seminar in Secondary Education.** (1) Investigation of the issues that form the context for teaching in secondary schools.
- 705. Sociology of Education.** (3) Study of contemporary society and education, including goals and values, institutional culture, and the teaching/learning process.
- 707. Educational Policy and Practice.** (3) Examination of the impact of race, ethnicity, and social class on educational achievement and attainment, including consideration of philosophical, historical, and sociological issues.
- 708. School and Society.** (3) Study of continuity and change in educational institutions, including analysis of teachers, students, curriculum, assessment and evaluation, and contemporary problems and reform movements.
- 711. Reading Theory and Practice.** (3) Study of current reading theory and consideration of its application in the teaching of reading, grades K-12.
- 712. Learning and Cognitive Science.** (3) Examination of patterns of human development, and theories and principles of cognition applied to teaching and learning.
- 713. Psychology of Learning: Classroom Motivation and Discipline.** (3) Study of the nature and fundamental principles of learning. Major learning theories and their implications for teaching problems. Cognitive processes, concept-formation, problem-solving, transfer of learning, creative thinking, and the learning of attitudes, beliefs, and values. Research in learning.
- 714. Instructional Strategies and Evaluation.** (3) Application of learning theories to instructional strategies and techniques and evaluation of various assessment techniques.
- 715. Action Research I.** (3) Individual planning for action research study on a specific pedagogical topic in a school setting. Includes definition of research problem, literature review, and proposal for collection of field data and reporting of results.
- 716. Professional Growth Seminar.** (2) Reflection and self-evaluation of student teaching experience and definition of professional goals.
- 717. Instructional Design, Assessment and Technology.** (3) Introduction to contemporary technologies and their applications for supporting instruction, assessment, professional practice, and school leadership.

- 721. Educational Research.** (3) Theory, construction, and procedures of empirical research on teaching and learning. Analysis and evaluation of published research studies.
- 723. Educational Statistics.** (3) Descriptive, inferential, and nonparametric statistical procedures involved in educational research. Computer methods for statistical analysis.
- 725. Action Research II.** (1) Reporting of results of action research study on pedagogical topic. Includes oral and written presentations.
- 730L. Service Learning: Tutoring.** (1) Practical experiences in classrooms with focus on tutoring and assisting with preparation for standardized testing. Includes field work and reflection. Pass/fail only.
- 731. Foundations of Curriculum Development.** (3) Philosophical, psychological, and social influences on the school curriculum. Examination of both theoretical and practical curriculum patterns for the modern school. Processes of curriculum development, including the leadership function of administration and research.
- 733. Supervision of Instruction.** (3) Analysis of various techniques of supervision: orientation of teachers, in-service education, classroom observation, individual follow-up conferences, ways to evaluate instruction, and methods for initiating changes.
- 735. Appraisal Procedures for Teachers.** (3) Overview of the development, interpretation, and application of tests of achievement, aptitude, interest, personality, intelligence, and other inventories commonly employed by teachers. Educational tests and measurement in the classroom. Test construction, validity, and reliability.
- 747. Research and Trends in the Teaching of Foreign Languages.** (3) Study of current trends and issues in foreign language education. Research topics include language and linguistics, culture, and technology.
- 751. Adolescent Psychology.** (3) Introduction to theories of adolescent psychology as related to teaching and counseling in various settings. Readings emphasize researchers' suggestions for parenting, teaching, and counseling adolescents between the ages of 13 and 19.
- 758. Studies in Educational Leadership.** (2) Examination of contemporary leadership theory and its various applications in education.
- 764. Seminar in Curriculum and Instruction.** (3) Exploration of special topics in the field of curriculum and instruction.
- 781. Methodology and Research.** (3) Advanced study of the methods and materials of a specific discipline (English, French, Spanish, social studies, mathematics, science) in the curriculum with special attention directed to the basic research in the discipline. Includes 20 hours field experience/project.
- 783. Readings and Research in Education.** (1-3) Independent study and research on topics relevant to the student's field of concentration which may include a special reading program in an area not covered by other courses or a special research project. Supervision by faculty members. Hours of credit to be determined prior to registration.
- 784. Research in Writing.** (3) Investigation of selected topics related to the writing process.
- 785. The Teaching of Writing.** (3) Examination of the theories and methods of instruction of writing.

787. Teaching Advanced Placement. (2 or 3) Investigation of the content of and the pedagogy appropriate to advanced placement courses in the various disciplines. A. English Literature and Composition; B. Calculus; C. English Language and Composition; J. Chemistry; L. U.S. Government and Politics; M. Psychology; I. U.S. History. Offered in summer only.

788. Teaching Foreign Languages in the Elementary Grades. (2) Intensive period of observation and instruction in an elementary school setting with a foreign language specialist. Methods for development of listening, speaking, reading, writing, and cultural awareness using content-based instruction and thematic units.

English (ENG)

Reynolda Campus

Chair Scott W. Klein

Associate Chair Dean J. Franco

Reynolds Professor of English Herman Rapaport

Charles E. Taylor Professor of English James S. Hans

Thomas H. Pritchard Professor of English Eric G. Wilson

Professors Anne Boyle, Mary K. DeShazer, Andrew V. Ettin, Claudia Thomas Kairoff,

Philip F. Kuberski, Barry G. Maine, William M. Moss, Gillian R. Overing, Gale Sigal

Associate Professors Dean J. Franco, Jefferson M. Holdridge, Scott W. Klein,

John R. McNally, Jessica A. Richard, Olga Valbuena-Hanson

Assistant Professors Rian E. Bowie, Susan Harlan, Omaar Hena, Melissa S. Jenkins,

Judith I. Madera, Erica L. Still

The courses for which credit may be earned toward the fulfillment of requirements for the MA degree offer opportunities for study and research in most of the major areas of both British and American literature and in the English language. The courses for graduates only (numbered above 700) stress independent study and research out of which theses may develop.

Applicants for graduate work in the department are expected to hold an undergraduate degree in English from an accredited institution. This major should consist of a well-rounded selection of courses demonstrating significant exposure to the range of literatures written in English and to ideas of literary history and interpretation. Candidates for degrees are required to have a reading knowledge of a modern foreign or classical language. After consulting with his or her advisory committee, the student can meet this requirement by making a satisfactory grade in an advanced reading course in a foreign language taken in residence at the University or by satisfactorily passing a translation examination administered by the English department. With approval of the department, a classical language may be substituted.

Foreign Language Requirement: This requirement may be fulfilled by passing a reading/translation proficiency test during the student's first academic year. Alternatively, a student may complete any one of the following: Spanish 197, 213, 217 or 218, French 197, 212, 213, 215 or 216, Italian 215 or 216, German 153x, Greek 211 or 212, Latin 211, 212, 216, or 218 with a grade of B. If the student does not pass the reading/translation exam during the first year, then he or she must complete the appropriate course with a grade of B. Other languages may be accepted upon approval by the graduate committee. During the summer before matriculating to Wake Forest, each student will take an online Foreign Language Placement Test. The score will help determine which alternative the student should pursue. Students enrolled in

the Interdisciplinary Graduate Certificate Program in Medieval Studies can use Old English, Old Norse, Provençal, or any other appropriate medieval language to fulfill the requirement. While no individual language course taken as an undergraduate may be used to fulfill the language requirement, evidence of 18 hours (six semesters) of undergraduate work in a single language will be accepted as fulfilling the requirement.

With approval by the departmental graduate committee, students may take one or two related courses in other departments.

601. Individual Authors. (3) Study of selected work from an important American or British author.

602. Ideas in Literature. (3) Study of a significant literary theme in selected works.

604. History of the English Language. (3) Survey of the development of English syntax, morphology, and phonology from Old English to the present, with attention to vocabulary growth.

605. Old English Language and Literature. (3) Introduction to the Old English language and a study of the historical and cultural background of Old English literature, including Anglo-Saxon and Viking art, runes, and Scandinavian mythology. Readings from *Beowulf* and selected poems and prose.

607. Dante I. (1.5) Study of the *Divine Comedy* as epic, prophecy, autobiography, and poetic innovation, relating it to antiquity, Christianity, Dante's European present (the birth of modern languages and new intellectual and poetic forms), and Dante's own afterlife in the West.

608. Dante II. (1.5) Completion of the course on the *Divine Comedy* as epic, prophecy, autobiography, and poetic innovation, relating it to antiquity, Christianity, Dante's European present (the birth of modern languages and new intellectual and poetic forms), and Dante's own afterlife in the West.

610. The Medieval World. (3) Through the reading of primary texts, this course examines theological, philosophical, and cultural assumptions of the Middle Ages. Topics may include Christian providential history, drama, devotional literature, the Franciscan controversy, domestic life, and Arthurian romance.

611. The Legend of Arthur. (3) The origin and development of the Arthurian legend in France and England with emphasis on the works of Chretien de Troyes and Sir Thomas Malory.

612. Medieval Romance and Allegory. (3) The origin and development of poetic genres and lyric forms of Middle English.

613. The Roots of Song. (3) Interdisciplinary investigation of poetry and song in the Middle Ages and early Renaissance. Study of the evolution of poetic and musical genres and styles, both sacred and secular. Students must complete a project or projects on the technical or theoretical aspects of early song.

615. Chaucer. (3) Emphasis on *The Canterbury Tales* and *Troilus and Criseyde*, with some attention to minor poems. Consideration of literary, social, religious, and philosophical background.

619. Virgil and His English Legacy. Study of Virgil's *Eclogues*, *Georgics*, and selected passages of the *Aeneid*, and their influence on English literature, using translations and original works by writers of the 16th through the 18th centuries, including Spenser, Marlowe, Milton, Dryden, and Pope. Knowledge of Latin not required.

620. British Drama to 1642. (3) British drama from its beginnings to 1642, exclusive of Shakespeare. Representative cycle plays, moralities, Elizabethan and Jacobean tragedies, comedies, and tragicomedies.

- 623. Shakespeare.** (3) Thirteen representative plays illustrating Shakespeare's development as a poet and dramatist.
- 625. 16th-Century British Literature.** (3) Concentration on the poetry of Spenser, Sidney, Shakespeare, Wyatt, and Drayton, with particular attention to sonnets and *The Faerie Queene*.
- 626. Studies in English Renaissance Literature.** (3) Selected topics in Renaissance literature. Consideration of texts and their cultural background.
- 627. Milton.** (3) The poetry and selected prose of John Milton with emphasis on *Paradise Lost*.
- 628. 17th-Century British Literature.** (3) Poetry of Donne, Herbert, Vaughan, Marvel, Crashaw, prose of Bacon, Burton, Browne, Walton. Consideration of religious, political, and scientific backgrounds.
- 630. British Literature of the 18th Century.** (3) Representative poetry and prose, exclusive of the novel, drawn from Addison, Steele, Defoe, Swift, Pope, Johnson, and Boswell. Consideration of cultural backgrounds and significant literary trends.
- 635. 18th-Century British Fiction.** (3) Primarily the fiction of Defoe, Richardson, Fielding, Smollett, Sterne, and Austen.
- 636. Restoration and 18th-Century British Drama.** (3) British drama from 1660 to 1780, including representative plays by Dryden, Etherege, Wycherley, Congreve, Goldsmith, and Sheridan.
- 637. Studies in 18th-Century British Literature.** (3) Selected topics in 18th-century literature. Consideration of texts and their cultural background.
- 640. Women and Literature.** (3) Selected topics.
- 644. Studies in Poetry.** (3) Selected topics in poetry.
- 645. Studies in Fiction.** (3) Selected topics in fiction.
- 646. Studies in Theatre.** (3) Selected topics in theatre.
- 650. British Romantic Poets.** (3) A review of the beginnings of Romanticism in British literature, followed by study of Wordsworth, Coleridge, Byron, Keats, and Shelley; collateral reading in the prose of the period.
- 651. Studies in Romanticism.** (3) Selected topics in European and/or American Romanticism with a focus on comparative, interdisciplinary, and theoretical approaches to literature.
- 653. 19th-Century British Fiction.** (3) Representative major works by Dickens, Eliot, Thackeray, Hardy, the Brontës, and others.
- 654. Victorian Poetry.** (3) A study of the Brownings, Tennyson, Hopkins, and Arnold or another Victorian poet.
- 657. Studies in Chicano Literature.** (3) Writings by Americans of Mexican descent in relation to politics and history. Readings in literature, literary criticism, and socio-cultural analysis.
- 658. Postcolonial Literature.** (3) Survey of representative examples of postcolonial literature from geographically diverse writers, emphasizing issues of politics, nationalism, gender, and class.
- 659. Studies in Postcolonial Literature.** (3) Examination of themes and issues in postcolonial literature, such as: globalization, postcolonialism and hybridity, feminism, nationalism, ethnic and religious conflict, the impact of the Cold War, and race and class.

- 660. Studies in Victorian Literature.** (3) Selected topics such as development of genres, major authors and texts, cultural influences. Reading in poetry, fiction, autobiography, and other prose.
- 661. Literature and Science.** (3) Literature of and about science. Topics vary and may include literature and medicine, the two-culture debate, poetry and science, nature in literature, the body in literature.
- 662. Irish Literature in the 20th Century.** (3) Study of modern Irish literature from the writers of the Irish Literary Renaissance to contemporary writers. Course consists of overviews of the period as well as specific considerations of genre and of individual writers.
- 663. Studies in Modernism.** Selected issues in Modernism. Interdisciplinary, comparative, and theoretical approaches to works and authors.
- 664. Studies in Literary Criticism.** (3) Consideration of certain figures and schools of thought significant in the history of literary criticism.
- 665. 20th-Century British Fiction.** (3) Representative major works by Conrad, Ford, Forster, Joyce, Lawrence, Woolf, and others.
- 666. James Joyce.** (3) The major works by Joyce, with an emphasis on *Ulysses*.
- 667. 20th-Century English Poetry.** (3) A study of 20th-century poets of the English language, exclusive of the U.S. Poets will be read in relation to the literary and social history of the period.
- 668. Studies in Irish Literature.** (3) The development of Irish literature from the 18th century through the early 20th century in historical perspective, with attention to issues of linguistic and national identity.
- 669. Modern Drama.** (3) Main currents in modern drama from 19th-century realism and naturalism through symbolism and expressionism. After an introduction to European precursors, the course focuses on representative plays by Wilde, Shaw, Synge, Yeats, O'Neill, Eliot, Hellman, Wilder, Williams, Hansberry, and Miller.
- 670. American Literature to 1820.** (3) Origins and development of American literature and thought in representative writings of the Colonial, Revolutionary, and Federal periods.
- 671. American Ethnic Literature.** (3) Introduction to the field of American Ethnic literature, with special emphasis on post World War II formations of ethnic culture: Asian American, Native American, African American, Latino, and Jewish American. The course highlights issues, themes, and stylistic innovations particular to each ethnic group and examines currents in the still developing American culture.
- 672. American Romanticism.** (3) Studies of Romanticism in American literature. Focus varies by topic and genre, to include such writers as Emerson, Thoreau, Hawthorne, Melville, Whitman, and Dickinson.
- 673. Literature and Film.** (3) Selected topics in the relationship between literature and film, such as adaptations of literary works, the study of narrative, and the development of literary and cinematic genres.
- 674. American Fiction before 1865.** (3) Novels and short fiction by such writers as Brockden, Cooper, Irving, Poe, Hawthorne, Melville, Stowe, and Davis.
- 675. American Drama.** (3) An historical overview of drama in America, covering such playwrights as Boucicault, O'Neill, Hellman, Wilder, Williams, Inge, Miller, Hansberry, Albee, Shepard, Norman, Mamet, and Wilson.

- 676. American Poetry before 1900.** (3) Readings and critical analysis of American poetry from its beginnings, including Bradstreet, Emerson, Longfellow, Melville, and Poe, with particular emphasis on Whitman and Dickinson.
- 677. American Jewish Literature.** (3) Survey of writings on Jewish topics or experiences by American Jewish writers. Explores cultural and generational conflicts, responses to social change, the impact of the Shoah (Holocaust) on American Jews, and the challenges of language and form posed by Jewish and non-Jewish artistic traditions.
- 678. Literature of the American South.** (3) Study of Southern literature from its beginnings to the present, with emphasis upon such major writers as Tate, Warren, Faulkner, O'Connor, Welty, and Styron.
- 679. Literary Forms of the American Personal Narrative.** (3) Reading and critical analysis of autobiographical texts in which the ideas, style, and point of view of the writer are examined to demonstrate how these works contribute to an understanding of pluralism in American culture. Representative authors include Douglass, Brent, Hurston, Wright, Kingston, Angelou, Wideman, Sarton, Hellman, and Dillard.
- 680. American Fiction from 1865 to 1915.** (3) Such writers as Twain, James, Howells, Crane, Dreiser, Wharton, and Cather.
- 681. Studies in African-American Literature.** (3) Reading and critical analysis of selected fiction, poetry, drama, and other writings by American authors of African descent.
- 682. Modern American Fiction, 1915 to 1965.** (3) Includes such writers as Cather, Lewis, Hemingway, Fitzgerald, Faulkner, Dos Passos, Wolfe, Baldwin, Ellison, Agee, O'Connor, Styron, Percy, and Pynchon.
- 683. Theory and Practice of Poetry Writing.** (3) Emphasis on reading and discussing student poems in terms of craftsmanship and general principles.
- 685. 20th-Century American Poetry.** (3) Readings of modern American poetry in relation to the literary and social history of the period.
- 686. Directed Reading.** (1-3) A tutorial in an area of study not otherwise provided by the department; granted upon departmental approval of petition presented by a qualified student.
- 687. African-American Fiction.** (3) Selected topics in the development of fiction by American writers of African descent.
- 689. African-American Poetry.** (3) Readings of works by American poets of African descent in theoretical, critical, and historical contexts.
- 690. Structure of English.** (3) Introduction to the principles and techniques of modern linguistics applied to contemporary American English.
- 691. Studies in Postmodernism.** (3) Interdisciplinary, comparative, and theoretical approaches to works and authors.
- 693. Multicultural American Drama.** (3) Examines the dramatic works of playwrights from various racial and ethnic communities such as Asian American, Native American, and Latino. Includes consideration of issues, themes, style, and form.
- 694. Contemporary Drama.** (3) Considers experiments in form and substance in plays from Godot to the present. Readings cover such playwrights as Beckett, Osborne, Pinter, Stoppard, Churchill, Wertebaker, Albee, Shepard, Mamet, Wilson, Soyinka, and Fugard.

- 695. Contemporary American Literature.** (3) Study of post-World War II American poetry and fiction by such writers as Bellow, Gass, Barth, Pynchon, Morrison, Ashbery, Ammons, Bishop, and Rich.
- 696. Contemporary British Fiction.** (3) Study of the British novel and short story, with particular focus on the multicultural aspects of British life, including work by Rushdie, Amis, Winterson, and Ishiguro.
- 697. Creative Nonfiction.** (3) A writing intensive course exploring the practice and theory of nonfiction, a genre that encompasses memoir, the personal essay, travel writing, and science writing.
- 698. Advanced Fiction Writing.** (3) Primarily a short story workshop with class discussion on issues of craft, revision, and selected published stories.
- 699. Advanced Expository Writing.** (3) Training and practice in writing expository prose at a level appropriate for publication in various print media, primarily magazines.
- 700. Teaching Internship.** (1.5) An internship for the observation and practice of undergraduate pedagogy, placing an MA student into a core literature course taught by a tenured or tenure-track professor, typically in the first semester of the student's second year. Arranged by permission or invitation of the supervising faculty member. Must be taken as an overload in addition to the coursework for the degree.
- 701. Individual Authors.** (3) Study of selected works from an important American, English, or Global Anglophone author.
- 702. Ideas in Literature.** (3) Study of a significant literary theme in selected works.
- 710. Early Medieval Narrative.** (3) A variety of forms of early medieval narrative (history, saga, chronicle, poetry, hagiography), with a focus on issues of genre and narrative form, connections between story and history, and the text's relation to the culture that produced it. Emphasis is on interdisciplinary viewpoints (artistic, archaeological, geographic), and on contemporary narrative theory.
- 711. Studies in the Arthurian Legend.** (3) Emphasis is on the origin and developments of the Arthurian legend in England and France, with primary focus on Malory's *Le Morte d'Arthur*. Attention to social and intellectual backgrounds.
- 712. Studies in Medieval Literature: Romance and Identity.** (3) A diverse corpus of medieval poetry, both lyric and narrative, is explored in an effort to trace the origin and evolution of the idea and meaning of "romance," a term signifying, for the medieval audience, narrative poetry in the vernacular, and, for our purposes, that uniquely new concept of ennobling love that emerged in the 12th century.
- 715. Studies in Chaucer.** (3) Emphasis on selected *Canterbury Tales*, *Troilus and Criseyde*, and the longer minor works, with attention to social, critical, and intellectual background. Lectures, reports, discussions, and a critical paper.
- 720. Renaissance Drama.** (3) Using an historical approach, this seminar examines the relationship between the theater as an institution and centers of authority during the Tudor and Stuart periods. The plays—tragedies, comedies, tragicomedies—are approached as the products of a dynamic exchange between individual authors and the larger political and social concerns of the period.
- 721. Studies in Spenser.** (3) Emphasis on *The Faerie Queene*; attention to the minor works; intellectual and critical background. Lectures, discussions, and class papers.
- 722. Studies in 16th-Century British Literature.** (3) Introduction to critical and scholarly methodology for the study of the literature; particular emphasis on Spenser's *Faerie Queene* and Sidney's *Arcadia*.

- 723. Studies in Shakespeare.** (3) Representative text from all genres, examined in light of critical methodologies in the field of Shakespeare studies. Emphasis is on reading primary sources as well as on discussion of the impact that historical, cultural, and religious developments had on Shakespeare, the theater, and the thematics of his plays.
- 725. Studies in 17th-Century British Literature.** (3) Non-dramatic literature of the 17th century, exclusive of Milton. Emphasis on selected major writers. Lectures, discussions, and presentation of studies by members of the class.
- 727. Studies in 17th-Century British Literature: Primarily Milton.** (3) The work of John Milton, primarily *Paradise Lost*, within its cultural environment. Some attention to connections between Milton's writings and that of his contemporaries.
- 733. 18th-Century British Fiction.** (3) A study of two major British novelists of the 18th century. Lectures, reports, critical papers. Authors for study chosen from the following: Defoe, Richardson, Fielding, Smollet, and Austen.
- 737. Studies in Restoration and 18th-Century British Literature.** (3) Selected topics in Restoration and 18th-century literature. Consideration of texts and their cultural background.
- 740. Studies in Gender and Literature.** (3) An examination of selected writers and/or theoretical questions focusing on issues of gender.
- 743. 19th-Century British Fiction.** (3) Study of one or more major British novelists of the 19th century. Lectures, reports, discussions, and a critical paper. Authors for study chosen from the following: Austen, Dickens, Thackeray, Eliot, and Hardy.
- 745. British Poetry of the 19th and 20th Centuries.** (3) Study of several British poets chosen from the major Romantics, Tennyson, Browning, Hardy, and Yeats.
- 746. Studies in British Romanticism.** (3) Examination of major writers, topics, and/or theoretical issues from the late 18th and early 19th centuries.
- 757. American Poetry.** (3) Studies of the poetry and poetic theory of three major American writers in the 19th and 20th centuries. Writers chosen from the following: Whitman, Dickinson, Frost, Eliot, Stevens, or Williams. Discussions, reports, and a critical paper.
- 758. Studies in Modern Poetry.** (3) Theoretical issues and themes in 20th-century poetry.
- 759. Studies in Postcolonial Literature.** (3) Examination of themes and issues in postcolonial literature and/or theory such as globalization, identity and hybridity, feminism, nationalism, ethnic and religious conflict, the impact of neo-imperialism and economic policy, and race and class.
- 765. Literary Criticism.** (3) Review of historically significant problems in literary criticism, followed by study of the principal schools of 20th-century critical thought. Lectures, reports, discussions, and a paper of criticism.
- 766. Studies in 20th-Century British Literature.** (3) Examination of major writers, topics and/or theoretical issues in 20th-century British literature. In addition to fiction, the course focuses on drama, theory, prose readings, and poetry.
- 767. 20th-Century British Fiction.** (3) Study of one or more of the major British novelists of the 20th century. Authors chosen from among the following: Conrad, Ford, Forster, Joyce, Lawrence, or Woolf.

768. Irish Literature. (3) Study of major themes, theories, individual authors, or periods, which might include discussions of mythology, folklore, landscape, poetics, narrative strategies, gender, and politics.

771. American Ethnic Literature. (3) Examination of how ethnic writers narrate cultural histories and respond to and represent the ambiguity of cultural location. Literary topics include slavery, exile, the Holocaust, immigration, assimilation, and versions of the American Dream.

772. Studies in American Romanticism. (3) Writers of the mid-19th century, including Emerson, Thoreau, Hawthorne, and Melville.

774. American Fiction Before 1865. (3) Study of novels and short fiction by such writers as Brown, Cooper, Irving, Poe, Hawthorne, Melville, Stowe, and Davis.

776. American Poetry Before 1900. (3) Close reading and critical analysis of selected American poets, such as Bryant, Longfellow, Poe, Emerson, Whitman, and Dickinson.

779. Autobiographical Voices: Race, Gender, Self-Portraiture. (3) Using an historical and critical approach, this seminar examines autobiography as an activity which combines history, literary art, and self-revelation. Lectures, reports, discussions, a critical journal, a personal narrative, and a critical paper. Authors for study chosen from the following: Douglass, Brent, Hurston, Wright, Angelou, Crews, Dillard, Moody, Malcolm X, Kingston, Wideman, or Sarton.

780. Studies in American Fiction from 1865 to 1915. (3) Study of the principal fiction of one or more major American writers of the late 19th and early 20th centuries. Lectures, seminar reports, and a research paper. Authors for study chosen from the following: Twain, James, Howells, Adams, Crane, Dreiser, Wharton, or Cather.

781. African-American Literature and the American Tradition. (3) Critical readings of selected works of major American writers of African descent within the contexts of the African-American and American literary and social traditions. Covers such genres as autobiography, fiction, drama, and poetry. Lectures, reports, discussions, and a critical paper.

782. Studies in American Fiction from 1915 to 1965. (3) Study of the principal fiction of one or more major American writers of the 20th century. Writers are chosen from the following: Cather, Lewis, Hemingway, Fitzgerald, Faulkner, Dos Passos, Wolfe, Baldwin, Ellison, Agee, O'Connor, Percy, or Pynchon.

783. Contemporary American Fiction. (3) Seminar devoted to the close study of some of the most important novels produced in the United States since World War II.

784. Contemporary American Poetry. (3) Seminar devoted to the close study of some of the most important poems written in America since World War II.

786. Directed Reading. (1-3) A tutorial in an area of study not otherwise provided by the department; granted upon departmental approval of petition presented by a qualified student.

789. Linguistics in Literature. (3) Examination of theories of grammar and attitudes toward the English language reflected in the literature of selected periods.

791, 792. Thesis Research. (1-9)

Health and Exercise Science (HES)

Reynolda Campus

Chair Michael J. Berry

Thurman D. Kitchin Professor of Health and Exercise Science W. Jack Rejeski

Charles E. Taylor Professor of Health and Exercise Science Paul M. Ribisl

Professors Michael J. Berry, Peter H. Brubaker, Stephen P. Messier

Associate Professors Anthony P. Marsh, Shannon L. Mihalko, Gary D. Miller, Patricia A. Nixon

Assistant Professor Jeffrey A. Katula

The Department of Health and Exercise Science offers a graduate program leading to the master of science degree. This program offers specialization in the area of health and exercise science and is designed for those who are interested in careers in research, preventive, and rehabilitative programs, and/or further graduate study.

Candidates for the health and exercise science program are not required to have a specific undergraduate major or minor. However, an undergraduate concentration in the sciences is preferred. Candidates for the program generally pursue research careers in exercise science laboratories (exercise physiology, biomechanics, or rehabilitation), and/or direct programs of exercise training or rehabilitation (YMCA's, corporate fitness programs, and cardiac rehabilitation). The prerequisites for this program include course work in human anatomy, human physiology, physiology of exercise, and biomechanics. These courses should be completed before admission to the program. None of the prerequisites may apply toward the graduate degree. All students in the program are required to take the following courses: 660, 675, 715, 721, 733, 761, 763, 765, 783-784 and 791-792. Students can normally expect to spend two years in this program. The first year is devoted to required coursework and the identification of a thesis topic. The research and data collection for the thesis are usually completed in the second year. The second year also allows an opportunity for elective coursework outside the department.

The Department of Health and Exercise Science supports the Healthy Exercise and Lifestyle Programs (HELPS), a chronic disease prevention program for the local community. As part of the coursework in HES 761 and 765, graduate students serve an internship in HELPS to gain practical experience as clinical exercise specialists. After serving an internship with HELPS during the first academic year, each student will have the opportunity to be certified as an American College of Sports Medicine (ACSM) exercise specialist.

The Department of Health and Exercise Science began offering graduate study in 1967. Departmental graduate committee: Marsh (chair), Berry, Brubaker, Katula, Messier, Mihalko, Miller, Nixon, Rejeski, Ribisl.

650. Human Physiology. (3) A lecture course that presents the basic principles and concepts of the function of selected systems of the human body, with emphasis on the muscular, cardiovascular, pulmonary, and nervous systems.

651. Nutrition in Health and Disease. (3) A lecture/lab course that presents the principles of proper nutrition including an understanding of the basic foodstuffs and nutrients as well as the influence of genetics, eating behavior, and activity patterns on performance, energy balance, and weight control. Labs focus on intervention in obesity and coronary heart disease through diet analysis, methods of diet prescription, and behavior modification.

652. Human Gross Anatomy. (4) A lecture/lab course on the structure and function of the human body. Labs are devoted to the dissection and study of the human musculoskeletal, neuromuscular, and vascular systems.

653. Physiology of Exercise. (3) Lecture course that presents the concepts and applications of the physiological response of the human body to physical activity. The acute and chronic responses of the muscular and cardiorespiratory systems to exercise are examined. Other topics include exercise and coronary disease, strength and endurance training, somatotype and body composition, gender-related differences, and environmental influences. P—HES 650 or POI.

660. Epidemiology. (3) Introduction to basic determinants of the incidence of chronic disease in the population, and development of an understanding of individual, community, and environmental approaches to promoting healthful lifestyles in youth, adults, and elderly populations. Issues are analyzed by formal statistical modeling.

670. Biomechanics of Human Movement. (3) Study of the mechanical principles which influence human movement, sport technique, and equipment design.

675. Advanced Exercise Physiology. (3) Lecture course which provides an in-depth examination of the physiological mechanisms responsible for both the acute and chronic changes which occur with exercise. Included are cellular changes in response to exercise, the ventilatory response to exercise and metabolic consequences of exercise.

682. Independent Study. (1-3) Literature reviews and/or laboratory research performed on an individual basis under the supervision of a faculty member.

715. Experimental Design. (3) Study of the various types of research relevant to health and exercise science. While attention is given to topics such as statistical treatment of data, the primary emphasis involves discussion concerning threats to internal and external validity for experimental and quasi-experimental designs. In conjunction with a sound methodological approach, practical experiences are provided in the preparation and presentation of thesis proposals.

721. Data Analysis and Interpretation. (3) The application of basic statistical techniques in the analysis and interpretation of data in scientific research. Topics include descriptive statistics, simple linear and multiple correlation/regression analysis, t-tests, analysis of variance and co-variance, and non-parametric statistics.

733. Health Psychology. (3) Seminar on current topics in health psychology with a focus on wellness programs and rehabilitative medicine.

761. Cardiopulmonary Disease Management. (3) A lecture/lab class that examines the physiologic, pathologic, and pharmacologic considerations of managing patients with cardiovascular and pulmonary disease. Special emphasis on learning diagnostic procedures, interventions, and therapies, particularly models for cardiac and pulmonary rehabilitation.

763. Advanced Biomechanics. (3) An in-depth study of the mechanical principles that influence human movement. Topics include the study of kinetics, kinematics, cinematography, sport shoe design, and skeletal biomechanics. P—Anatomy, kinesiology, physics, or POI.

765. Graded Exercise Testing and Exercise Prescription. (3) The study of the rationale for the use of graded exercise testing in the evaluation of functional work capacity and prescription of exercise. Lectures include the analysis of different modes of evaluation: treadmill, bicycle ergometer, arm ergometer,

and field testing, with the application of the results in the evaluation of normal and cardiac patients and prescription of exercise for special populations. Lab experiences include the use of electrocardiographs, ergometers, and metabolic analyzers in the assessment of functional capacity.

780. Advanced Topics in Exercise and Sport Science. (3) This course is divided into two or more content areas to allow an in-depth treatment of selected topics that are not a regular part of required coursework. Topics are chosen from the following areas: anatomy, biomechanics, computer analysis, multivariate statistics, and physiology of exercise. Seminar and/or lab approach.

782. Independent Study in Health and Exercise Science. (1-3) Literature and/or laboratory research performed on an individual basis under the supervision of a faculty member.

783, 784. Seminar in Health and Exercise Science. (1, 1) Seminar class designed to bring graduate students and faculty together on a regular basis to discuss research proposals, research design and studies, results of research, and current topics in health and exercise science. Talks by invited or visiting speakers are included as seminar sessions. Graduate students receive reading and work assignments related to the material presented in the seminar. May be repeated for credit.

791, 792. Thesis Research. (1-9)

Integrative Physiology and Pharmacology (IPP) Track 5

Bowman Gray Campus

Professors Karl-Erik Andersson, Anthony Atala, Michael Berry, Bridget Brosnihan, Pete Brubaker, Mark Chappell, Martin Childers, Steven R. Childers, Floyd H. Chilton, George Christ, J. Mark Cline, Samuel A. Deadwyler, Debra Diz, Thomas Dubose Jr., James Eisenach, J. Charles Eldridge, Carlos Ferrario, Jorge Figueroa, David P. Friedman, Pradeep Garg, Randolph Geary, William Gmeiner, Dwayne Godwin, Scott E. Hemby, Allyn Howlett, Jay Kaplan, Nancy Kock, Stephen Messier, Mark Miller, Lorna Moore, Michael A. Nader, Barbara Nicklas, John S. Parks, Linda Porrino, Jack Rejeski, Paul Ribisl, Jim Rose, Carol Shively, Tom Smith, Shay Soker, Jack Strandhoy, Ann Tallant, Mary Sorci-Thomas, Janice Wagner, Richard Weinberg, Jeffrey L. Weiner, James Yoo

Associate Professors Patricia Gallagher, Leanne Groban, Robert E. Hampson, Greg Kucera, Anthony Liguori, Anthony P. Marsh, Thomas Martin, Shannon Mihalko, Gary Miller, Nilamadhab Mishra, Michelle Nicolle, Pat Nixon, Tom Register

Assistant Professors Thomas J.R. Beveridge, J. Mark Borwn, Evgeny A. Budygin, Michael Callahan, Rong Chen, Paul Czoty, James Daunais, Delrae Eckman, Jim Jordan, Matthew Jorgenson, Jeff Katula, Kylie Kavanaugh, Cynthia Lees, Snezana Petrovic, Victor Pulgar, Andrew Sweatt, Mark VanDyke, Jasmina Varagic, Patricia Wilson

Lecturers Dave Stroupe, Johnnie Foye Talley, Sharon Woodard

Integrative Physiology and Pharmacology at Wake Forest University offers a PhD program designed to train students for a research career in the physiological and pharmacological sciences. The IPP program has excelled in obtaining federal and foundational funding for many years, with dozens of highly-funded investigators working in a highly collaborative research environment. Research interests of the IPP program include a strong emphasis on drug and alcohol abuse, life-span physiology, cardiovascular disease, cancer, the endocrine system, central pain modulation, neuropsychiatric disorders, and regenerative medicine.

All students admitted to the program receive full financial support. The program admits up to seven new students each year; there are currently 21 PhD students in various stages of training, and there are 71 full-time primary and adjunct faculty members.

701. Principles of Pharmacology. (3) The first required course for physiology and pharmacology students introduces students to basic principles of physiology and pharmacology and the cellular, ADME principles (administration, distribution, metabolism, elimination), pharmacokinetics, and pharmacodynamics (receptors and signal transduction).

702. Systems Physiology and Pharmacology. (1-6) The second required course for physiology and pharmacology students is composed of five blocks of physiology and pharmacology including blocks on neurophysiology/neuropharmacology (Block 1), cardiovascular physiology/physiology (Block 2), pulmonary/renal systems (Block 3), endocrine physiology/ pharmacology (Block 4) and gastrointestinal and regenerative physiology (Block 5). Each block can be taken for 1 credit.

703, 704. Student Seminar. (1) Students present seminars as well as attend seminars by other IPP students and post-doctoral researchers. Students alternatively present a seminar or provide a written critique of a journal article. Course may be repeated.

705, 706. Student Journal Club. (1) Students participate in a journal club as well as attend a required number of seminars by faculty/outside speakers. Course may be repeated.

711, 712. Advanced Topics. (1-6) An advanced lecture and conference course that considers various topics of current research interest and concepts under rapid development. Areas of interest within the department are covered on a rotating basis. Additional topics can be offered by announcement.

713, 714. Advanced Readings. (1-4). Individualized instruction involving detailed review of literature pertaining to a specific area of interest in physiology or pharmacology.

715. Physiological Techniques. (2) Provides students with an introduction to the techniques used to assess physiological parameters by a combination of lectures and demonstrations.

717. Current Topics in Drug Abuse. (2-3) Provides students with perspective in the problem of drug abuse. Defines the basic issues central to the field of drug abuse, including concepts of tolerance, physical dependence and reinforcement mechanisms, and relate these issues to the current problems of drug abuse in society. Describes how current research in drug abuse contributes to the design of rational treatment and prevention programs. Also listed as NEUR 717.

722. Behavioral Pharmacology. (3) Focuses on behavioral factors that influence the effects of drugs. Material presented provides a detailed review of the rate-dependent, reinforcing, and stimulus effects of drugs. Additional topics include behavioral factors related to tolerance and sensitization and a review of animal models of drug action. Also listed as NEUR 722.

724. Biology of Alcohol Abuse—Alcoholism. (3) Designed to instruct graduate and postdoctoral students on the pharmacological, physiological, and behavioral effects of alcohol. Lectures cover topics ranging from the epidemiology and etiology of alcohol abuse and alcoholism to the basic biochemistry, metabolism, and pharmacokinetics of alcohol in the mammalian system. Lectures focusing on the effects of alcohol on the nervous system include neuroreceptor interactions, ethanol's effects on intracellular signaling processes, neuroanatomical substrates for the actions of alcohol, systems electrophysiology, and mechanism of the behavioral effects of alcohol such as the reinforcing effects, anxiolytic effects, amnesic

effects, and motor impairing effects. These lectures provide the basis for an exploration of the conditions leading to tolerance and dependence, and how the brain adapts to prolonged exposure to alcohol. Also listed as NEUR 724.

726. Toxicology. (2) Lecture course designed to provide the student with the basic concepts and mechanisms underlying toxic responses to xenobiotics. Emphasis is on the toxicology relevant to the diagnosis and prevention of poisoning in humans from occupational, environmental, or iatrogenic origin. Broad area studies are general principles of toxicology, common toxic agents, and target organs. Experimental models and methodologies of risk assessment are explored.

730. Lifespan Physiology and Pharmacology. (2) Lectures on the physiology of development and aging and the study of drugs during development and aging. Presentations address current topics relevant to age-dependent changes in various organ systems and theories of aging. The topics of age-related alterations in drug absorption, kinetics, and metabolism are also examined.

731. Perinatal Physiology I. (2) Discussion of literature in physiology and pharmacology concerning developmental aspects of mammalian organ systems. Emphasis is on the cardiovascular, endocrine and renal systems with considerations of the consequences of fetal programming of these systems.

732. Perinatal Physiology II. (2). Discussion of literature in physiology and pharmacology concerning developmental aspects of mammalian organ systems. Emphasis is on developmental pharmacology and the ability of drugs to program development.

736. Endocrinology. (2) Recent advances in endocrinology, with emphasis on receptor-linked functions, hormonally-active drugs, and influences of pharmacologic agents on endocrine function. In a tutorial setting, students study principles of structure and function, examine current technology and published literature, and design and critique experimental approaches.

738. Cardiovascular Physiology and Pharmacology. (2) Lectures, readings and discussions center on normal and abnormal cardiovascular physiology and recent developments in drugs affecting the heart and circulation.

740. Neuropharmacology. (2-3) General survey of neuropharmacology, emphasizing neurotransmitters, receptors and their interactions. Discussion of published literature with some lectures. Discusses general principles of drug action, including receptor binding, second messengers, and neurotransmitter metabolism. Surveys neurotransmitter function, including acetylcholine, biogenic amines, excitatory and other amino acids, and neuropeptides. Also covers techniques used to measure receptor function.

741. Quantitative Methods in Behavioral Science. (2). Addresses applied statistical approaches within common behavioral research studies. Focus is on selection of the most appropriate test for research aims and hypotheses as well as computational methods. Specific topics include power analyses, effect sizes, analyses of variance, t tests, correlation, regression, nonparametric tests, chi square, and post hoc testing. Also listed as NEUR 741.

797, 798. Research. Mentored research on physiological or pharmacological problems in preparation for the thesis. Course may be repeated.

Interpreting and Translation Studies

Reynolda Campus

Co-Directors Olgierda Furmanek, Sarah E. Barbour

Charles E. Taylor Professor of Romance Languages Candelas Gala

Professors Jane W. Albrecht, Mike Hazen, M. Stanley Whitley,

Associate Professors Irma V. Alarcón, Olgierda Furmanek, Luis González

Assistant Professors Jerid Francom, Annegret Hannawa, Stephanie Pellet

Adjunct Professor Jules Guilbeau

Instructor Diego Burgos

This program offered by the Department of Romance Languages prepares professionals for working in the growing language industry as it relates to a variety of fields—foreign affairs, media, business, law, and especially healthcare delivery. Underscoring the growing demand for language services in healthcare delivery, medical institutions are required as of January 1, 2011, to provide interpreting and translation services to patients with limited English proficiency. The current lack of interpreters and translators has led the U.S. Department of Labor to project a 22 percent increase in employment over the next decade. The program in interpreting and translation studies will not only help meet this demand, but also responds to Wake Forest’s “*Pro Humanitate*” motto, as its graduates will serve underprivileged communities while at the same time contributing to the quality of mainstream healthcare delivery and demonstrating the strong connections between liberal arts education and public service. The program offers three MA tracks: Interpreting and Translation Studies, Intercultural Services in Healthcare and Teaching of Interpreting.

The Interpreting and Translation Track is a language-specific, professionally oriented and research-based program that prepares interpreters and language specialists for working in the language industry with special emphasis on healthcare delivery. Graduates of this program will have a solid foundation in applied interpreting and translation studies, analysis of contextual meaning and extra-linguistic aspects of communication, cross-cultural awareness, sociolinguistics and dialectology, localization and terminology management, and advanced technologies for linguistic services. This program is especially appropriate for those who intend to pursue a doctorate in this field.

The Teaching of Interpreting Studies Track is a non-language-specific program that prepares graduates to be instructors in community or college-level interpreter training programs. It is the only program in the Northern hemisphere to focus on methodology of teaching interpreting in the medical context. Graduates of the program will not only provide their students with a set of techniques on how to interpret, but they will also teach, mentor, and raise awareness about the interpreting practice. The curriculum lays the foundation for understanding the interpreting encounter, the co-conversational process and sociocultural determinations. It also includes a broad interdisciplinary research component, which is absent from the training seminars/workshops of other, non-academic programs.

The Intercultural Services in Healthcare Track is a non-language-specific program and is the first such specialization in the U.S. It prepares graduates to enter managerial positions in culture-sensitive healthcare delivery areas such as bilingual employment, patient relations, translation and interpreting services, health discourse and health messages. The curriculum provides a solid foundation in cross-cultural health communication, sociolinguistics, applied interpreting and translation studies, written and oral discourse analysis, medical translation, advanced technologies for linguistic services, localization and terminology management, organizational behavior, and health promotion as related to ethnicity.

Foreign Language or Special Skills Requirements.

The Interpreting and Translation Track. Applicants who do not have a college or high school degree from another country are required to take an interpreting aptitude assessment in their non-native language.

The Teaching of Interpreting Studies Track. Proven interpreting experience is required for this program.

The Intercultural Services in Healthcare Track. Foreign language competency is desirable, but not required for this program

Graduate Certificates

For students who are not able or ready to commit to earning a Master of Arts degree in interpreting and translation studies, but who would like to focus on an area of interest, the program offers several Graduate Certificates in specialized areas. Pairing various certificates provides a comprehensive package for students to reach their career goals in a more flexible, customized manner. Credits from a certificate program can often be transferred to a graduate degree program. A student who chooses to complete three certificates can meet the requirements for an MA in Interpreting and Translation Studies.

The program offers five graduate certificates:

Graduate Certificate in Interpreting Studies (language-specific)

Graduate Certificate in Translation Studies (language-specific)

Graduate Certificate in Audiovisual Translation and Interpreting (language-specific)

Graduate Certificate in Intercultural Services in Healthcare

Post-Graduate Certificate in Teaching of Interpreting (offered to students holding an MA, MS, or MBA degree)

Foreign Language or Special Skills Requirements for Certificates.

The Graduate Certificate in Interpreting Studies, the Graduate Certificate in Translation Studies and the Graduate Certificate in Audiovisual Translation and Interpreting are language-specific. Applicants who do not have a college or high school degree from another country are required to take an interpreting aptitude assessment in their non-native language. Proven interpreting experience is required for the Post-Graduate Certificate in Teaching of Interpreting.

TIS 730. Applied Translation Studies. (3) Examines the theory and practice of translation from a variety of linguistic and cultural angles. Introduces key concepts such as relevance, equivalence, skopos, back-translation, and explores critical approaches depending on the translated text types.

TIS 731. Applied Interpreting Studies. (3) Explores connections between research and practical issues in studies of interpreting (simultaneous, consecutive, bilateral and other modalities). Focuses on the interdisciplinary nature of the interpreting field and, based on case studies, examines the interface between interpreting as a profession, research in interpreting studies, and the teaching of interpreting. Students are required to complete a research project.

TIS 732. Methodology of Teaching Interpreting. (3) Addresses syllabus design and lesson planning for teachers of interpreting in a field-specific context. It focuses on the development of interpreting skills, including recent technological developments. It explores classroom management options and strategies

for providing feedback to students and covers internship design methods, including an on-site observation of various interpreting settings. Overall program design and methodology for teaching other courses in the interpreting curriculum will be also discussed.

TIS 735. Discourse Organization and Interpreting. (3) Explore the links between social situations, interlocutors, and the functional aspects of communicative events. Focuses on several important methodological approaches that have been developed to do discourse analysis in as much as they highlight important features of translation and interpreting. Students will review the varied traditions around meaning-making, including sociolinguistics, conversation analysis, critical discourse analysis, and discursive psychology. Readings will tie in traditional topics in discourse analysis with specific issues in translation and interpreting. This course will link theory to practice. One session per week will be devoted to practical, hands-on activities using real world data in various formats: written transcripts, aural speeches, or videos.

TIS 736. U.S. Heritage Speakers and Bilingualism. (3) Provides a comprehensive introduction to the fields of heritage languages, bilingualism, and bilingual education from a cross-disciplinary perspective. Covers a wide variety of topics, including, among others, individual and societal conceptions of heritage and dominant languages, general bilingual educational issues, bilingualism and multilingualism as they relate to identity, political and ideological issues, Spanish in the U.S.

COM 650. Intercultural Communications. (3) Explores the communicative process that occurs when two or more people from different national cultures interact with each other (on a face to face basis). Students will learn to understand the variables that affect the success or failure of an intercultural interaction and to enhance competence in communicating with people from different cultures. Develops an appreciation for other cultures and your native culture, enhances mutual understanding and harmony between people from different cultures and teaches students to understand what is similar and what is different about communication in various cultures. Students will develop critical grounds for recognizing the strengths and weaknesses of cultures.

COM 653. Health Communication. (3) Examination of theories, research and processes of health communication in contemporary society.

LIN 610. Sociolinguistics and Dialectology. (3) Explores how and why language varies, with emphasis on the social context of speech. Students will learn survey methods for describing language variation, from traditional dialectology to modern discourse analysis. Evaluates the social, educational, and political implications of dialect variation, gender and ethnic differences, and other social variables in language differences. Suggested prerequisite: LIN/ANT 150

LIN 680. Language Use and Technology. (3) Provides students with the opportunity to become familiar with the practical and theoretical issues concerned with creating and accessing large linguistic corpora (electronic collections of “real world” text) with computers for a host of applications; both academic and professional. Students will discuss the advantages of approaching language through empirical data collected from real-world sources; in addition, the course will highlight conceptual and practical aspects that pose challenges to creating robust, representative language samples. Designed to provide students with opportunities to discover new angles to their current academic or professional interests through the use of large-scale data sources and the power of computers.

LIN 683. Localization and Terminology. (3) Students will gain a familiarity with the language industry and understand the factors involved in the localization process. In addition, they will be able to appreciate the advantages of using computer assisted tools during this process, but also recognize the

limitations and disadvantages of this approach. Apart from tool usage, students will also be able to analyze the various steps in the localization of a product to determine the most appropriate process to achieve the highest quality possible. Finally, students' translation and research skills will improve through the examination of available resources and the creation of translation resources.

MGT 8110. Organizational Behavior. (3) Focuses on the understanding of employee behaviors and attitudes that ultimately contribute to organizational success or failure. Identifies critical organizational factors that influence workers, the processes by which these factors exert their influence and ways of applying this knowledge within organizations. The course is based on principles of scientific inquiry and knowledge from the behavioral sciences. All managers have traditionally been held accountable for influencing their employees' levels of job satisfaction, absenteeism, turnover and performance. The focus here is on understanding current managerial approaches, models and methods for influencing these critical outcomes. The course covers individual, group and organizational influences on organizational effectiveness.

MGT 5783. Healthcare Landscape. (3) Future advancements and potential obstacles in effective healthcare delivery can best be anticipated by understanding the historical and cultural influences that have shaped healthcare in the U.S. In addition to gaining a general knowledge of these influences and their economic impact, students will develop an expanded understanding of medical care delivery in an economic environment that is focused on improving the quality of healthcare while concurrently containing costs. Students will also gain a functional knowledge of assessment and planning models to address inefficiencies in delivery systems.

SPN 624. Contrastive Spanish/English Grammar and Lexicon. (3) Advanced study of structures and vocabulary, with an emphasis on common transfer mismatches in healthcare settings. Exploration of general principles behind 'atom-like' rules and the main lexical dichotomies, and how implications for meaning help in choosing the best option. Discussion of structures that are usually taught as idiomatic but are more compositional than previously thought: satellite-frame versus verb frame constructions, datives, verb+particle, reflexive constructions, etc.

SPN 625. Medical-Scientific Translation. (3) Students will develop and refine a practical translation skill set within the scientific and medical domains, and will gain familiarity with textual conventions that govern source and target texts within these domains and deepen their understanding of both Spanish and English as language for special purposes. Apart from translation proper, students will also be able to analyze texts for register, style, tone and content to determine the most appropriate process to achieve the highest quality translation. Finally, students' research skills will improve through the examination of available resources and the creation of domain-specific resources.

SPN 682. Spanish-English Interpreting. (3) An introductory course to the art of oral translation. Develops basic strategies useful in community, conference, court, escort and other types of interpreting. Current employment opportunities in the field of interpreting will be also briefly presented. Focuses on learning and practicing interpreting techniques. Individual, at home, preparation—besides the assigned readings and interpreting exercises—will also include a strong terminology enhancement.

Liberal Studies (MLS)

Reynolda Campus

Chair David Coates, political science

Program Coordinator Wanda S. Duncan

The liberal studies program enables the college-educated adult student to pursue graduate study in the liberal arts. The coursework consists of both courses designed specifically for the liberal studies program and courses available in the University curriculum. Students are encouraged to use this flexibility to tailor interdisciplinary programs to suit their particular needs and interests.

Applicants for the liberal studies program should have demonstrated an ability to succeed in a graduate-level humanities program. Ability to succeed is determined by either having obtained a B average in undergraduate work or at least two Bs in graduate level courses. Because of the nature of the program, no specific undergraduate major is required. However, the applicant should have taken courses in the humanities area as an undergraduate or graduate and should express appropriate interest in an interdisciplinary humanities degree program.

Liberal studies courses numbered above 700 are specially designed interdisciplinary graduate seminars for students enrolled for the master of liberal arts degree (MALS). Students have the option of completing the MALS degree with a capstone project or final thesis, or they may choose the non-thesis option by completing two additional courses and a paper which synthesizes their experience in the MALS program. A minimum of four liberal studies courses is required in the thesis option; a minimum of five liberal studies courses is required in the non-thesis option. Students may elect a maximum of five departmental 600- and 700-level courses that carry 3 hours of graduate credit; no more than four 600-level courses may count toward the MALS degree. The Directed Study Course (MLS 786) as well as MLS 693/694 do not count toward the requirement of four liberal studies courses. The following list of courses is a representative rather than a complete list.

705. Myths of Creation. (3) Explores a variety of ancient and “primitive” mythological texts concerned with the origins of the cosmos, the gods, and humanity. Selections from Hindu, Buddhist, Native American, Babylonian, Egyptian, Hebrew, Greek, Persian, and Norse mythology are examined within their respective cultures as well as in comparative context. Attention is given to various anthropological and psychological theories of myth and literary methods of myth analysis. We also explore the creative re-interpretations of the Biblical images of Adam and Eve in the Garden of Eden. The course concludes with a consideration of the survival of myth in the post-modern world and the relationship of the mythological imagination to scientific explanations of universal origins.

786. Directed Study. (1-3) Working with a faculty advisor, the student completes a special reading project in an area not covered in regular courses or a special research project not related to the master’s thesis. A student who wishes to enroll must submit the Directed Study Form, signed by the advisor, to the program director. May be repeated once for credit with the permission of the program director. Staff.

791. Thesis Research. (3)

848. Religion, Culture, and Capitalism. (3) Focuses on some of the ways that capitalism, religion, and culture intersect across time and geographical areas, including the evolution of capitalism in Protestant Europe, its transmission to the Americas, and historical and contemporary responses in select case studies. Students will look at how history has linked capitalism with religious teachings in theory and practice. Encourages critically informed thinking on the topic and promote appreciation for cultural pluralism and the global human struggle in creating life-affirming economic, religious and cultural systems.

849. Shaping our Environment: Urban Design and Public Policy. (3) Examines how our world is impacted by design of the urban environment, and the ways in which cities and their landscapes are controlled and shaped by public policy and planning practices. Students will develop perceptual awareness of the characteristics of built space and ways of describing it and visualizing it. Course readings draw from studies in urban design, urban planning, architecture, and public policy and housing studies. In addition to examining what makes for good design and how it affects us, the course focuses on methods for analyzing urban space and applying our observations in making proposals for intervention and improvement.

851. Paper Dreams: The History of Finance. (3) Much of what we value most—our ability to travel, to have a nice wedding, to finance our home and our children's education, and to retire with dignity—rests on a fragile global financial system that few people understand. This course explores how this financial system developed in an attempt to discover how we became so dependent on it and why it is so subject to periodic breakdowns. Topics include the early importance of the family, the Church, and slave-holding as sources of credit, the development of public debt and its impact on traditional patterns of investment and lending, the sources of corruption and instability in modern capital markets, and the social ramifications of consumer credit and micro-lending.

852. Hollywood Renaissance: American Cinema of the 1970s. (3) During the decade of the 1960s, the old Hollywood system of filmmaking was on the brink of total collapse. A recent Supreme Court decision had shaken the industry's way of doing business to its foundation, leaving the old guard with no workable business model with which to support its creative community. Meanwhile, a cadre of young filmmakers, steeped in the youth culture of the 60s and fascinated by avant-garde aesthetic trends in European cinema, successfully stormed the gates of an industry that a decade earlier would have been utterly inaccessible to them. As the 1970s dawned, the inmates were about to take over the asylum. The resulting revolution would leave in its wake some of the most astonishingly creative films ever seen within the bounds of mainstream Hollywood. This course seeks to explore that extraordinary period in the history of American cinema from aesthetic, industrial, and social viewpoints.

Mathematics (MTH)

Reynolda Campus

Chair Stephen B. Robinson

Reynolds Professor Robert J. Plemmons

Professors Edward E. Allen, Richard D. Carmichael, Hugh N. Howards, Ellen E. Kirkman, James Kuzmanovich, James L. Norris III, Stephen B. Robinson

Z. Smith Reynolds Foundation Faculty Fellow and Associate Professor Kenneth S. Berenhaut

Associate Professors, Miaohua Jiang, Sarah Raynor

Sterge Faculty Fellow and Assistant Professor Jennifer Erway

Assistant Professors Sarah Mason, Jason Parsley, Jeremy Rouse

Teacher-Scholar Postdoctoral Fellows Larissa Horn, Xiaofei Hu,

Keir Lockridge, Hannah Robbins

Research Professors John Baxley, Fredric T. Howard

The department offers a program of study leading to the master of arts degree in mathematics. The program is designed to accommodate students seeking either a terminal master's degree or preparation for PhD work.

To obtain the MA in one year, a graduate student must present evidence of having completed the work required of an undergraduate who majors in mathematics in a fully accredited college or university. Such a major is understood to include at least 33 semester hours of mathematics, of which at least 18 require as prerequisite one year of calculus. Students who are admitted with less than the level of preparation specified should expect to take additional courses at the 600-level and remain in residence for more than one year.

The requirements for the MA degree may be met in either of two ways, depending upon whether or not a thesis is submitted. If a thesis is written, 30 semester hours of coursework, including MTH 791, 792, and at least four additional courses numbered above 700, are required for the MA degree. If a thesis is not written, 36 semester hours of coursework, including at least five courses numbered above 700, are required for the MA degree. Math 791 and 792 cannot be counted as part of this coursework. An advanced course is required in each of the areas of analysis, algebra, and topology; normally this requirement is met with the courses 711, 721, 731. With the approval of the graduate adviser, graduate courses may be taken in related areas to fulfill requirements; however, no more than 6 such hours may count toward the requirements for either the thesis or non-thesis option.

Students desiring to use work taken in the department for graduate teacher certification should consult the Department of Education before applying for candidacy.

Computers are used in mathematics in conjunction with coursework and research. The department utilizes UNIX-based workstations and file servers along with microcomputers connected to local and wide-area networks. Access is available to the University's computing facilities, supercomputers at the North Carolina Supercomputing Center and other specialized computing equipment.

605. Applied Multivariable Mathematics. (3) Introduction to several topics in applied mathematics including complex numbers, probability, matrix algebra, multivariable calculus, and ordinary differential equations. May not be used toward any graduate degree offered by the department.

606. Advanced Mathematics for the Physical Sciences. (3) Advanced topics in linear algebra, special functions, integral transforms, and partial differential equations. May not be used toward any graduate degree offered by the department. P—MTH 605.

610. Advanced Calculus. (3) A rigorous proof-oriented development of important ideas in calculus. Limits and continuity, sequences and series, pointwise and uniform convergence, derivatives and integrals. Credit not allowed for both MTH 610 and 611. May not be used toward any graduate degree offered by the department.

611, 612. Introductory Real Analysis I, II. (3, 3) Limits and continuity in metric spaces, sequences and series, differentiation and Riemann-Stieltjes integration, uniform convergence, power series and Fourier series, differentiation of vector functions, implicit and inverse function theorems. Credit not allowed for both MTH 610 and 611.

617. Complex Analysis I. (3) Analytic functions. Cauchy's theorem and its consequences, power series, and residue calculus. Credit not allowed for both MTH 603 and 617.

622. Modern Algebra II. (3) A continuation of modern abstract algebra through the study of additional properties of groups, rings, and fields.

624. Linear Algebra II. (3) A thorough treatment of vector spaces and linear transformations over an arbitrary field, canonical forms, inner product spaces, and linear groups.

626. Numerical Linear Algebra. (3) Numerical methods for solving matrix and related problems in science and engineering. Topics include systems of linear equations, least squares methods, and eigenvalue computations. Special emphasis given to parallel matrix computations. Beginning knowledge of a programming language such as Pascal, FORTRAN, or C is required. Credit not allowed for both MTH 626 and CSC 652.

631. Geometry. (3) An introduction to axiomatic geometry including a comparison of Euclidean and non-Euclidean geometries.

634. Differential Geometry. (3) Introduction to the theory of curves and surfaces in two and three dimensional space including such topics as curvature, geodesics, and minimal surfaces.

645, 646. Elementary Theory of Numbers I, II. (3, 3) Properties of integers, including congruences, primitive roots, quadratic residues, perfect numbers, Pythagorean triples, sums of squares, continued fractions, Fermat's Last Theorem, and the Prime Number Theorem.

647. Graph Theory. (3) Paths, circuits, trees, planar graphs, spanning trees, graph coloring, perfect graphs, Ramsey theory, directed graphs, enumeration of graphs and graph theoretic algorithms.

648, 649. Combinatorial Analysis I, II. (3, 3) Enumeration techniques, generating functions, recurrence formulas, the principle of inclusion and exclusion, Polya theory, graph theory, combinatorial algorithms, partially ordered sets, designs, Ramsey theory, symmetric functions, and Schur functions.

652. Partial Differential Equations. (3) Detailed study of partial differential equations, including the heat, wave, and Laplace equations, using methods such as separation of variables, characteristics, Green's functions, and the maximum principle.

653. Mathematical Models. (3) Development and application of probabilistic and deterministic models. Emphasis given to constructing models that represent systems in the social, behavioral, and management sciences.

654. Discrete Dynamical Systems. (3) Introduction to the theory of discrete dynamical systems as applied to disciplines such as biology and economics. Includes methods for finding explicit solutions, equilibrium and stability analysis, phase plane analysis, analysis of Markov chains and bifurcation theory.

655. Introduction to Numerical Methods. (3) Numerical computations on modern computer architectures; floating point arithmetic and round-off error. Programming in a scientific/engineering language (C or FORTRAN). Algorithms and computer techniques for the solution of problems such as roots of functions, approximation, integration, systems of linear equations and least squares methods. Credit not allowed for both MTH 655 and CSC 655.

656. Statistical Methods. (3) Study of statistical methods that have proven useful in many different disciplines. These methods include tests of model assumptions, regression, general linear models, non-parametric alternatives, and analysis of data collected over time. Knowledge of matrix algebra is desirable but not necessary.

657, 658. Mathematical Statistics I, II. (3, 3) Probability distributions, mathematical expectation, sampling distributions, estimation and testing of hypotheses, regression, correlation, and analysis of variance.

659. Multivariate Statistics. (3) Multivariate and generalized linear methods for classification, modeling, discrimination, and analysis. P—MTH 602 and 656; or POI.

661. Selected Topics. (1, 1.5, 2, or 3) Topics in mathematics that are not considered in regular courses. Content varies.

681. Individual Study. (1 or 2) A course of independent study directed by a faculty adviser. By prearrangement.

682. Reading in Mathematics. (1, 2, or 3) Reading in mathematical topics to provide a foundational basis for more advanced study in a particular mathematical area. Topics vary and may include material from algebra, analysis, combinatorics, computational or applied mathematics, number theory, topology, or statistics. May not be used to satisfy any requirement in the mathematics MA degree with thesis. No more than three hours may be applied to the requirements for the mathematics MA degree without thesis.

711, 712. Real Analysis. (3, 3) Measure and integration theory, elementary functional analysis, selected advanced topics in analysis.

715, 716. Seminar in Analysis. (1, 1)

717. Optimization in Banach Spaces. (3) Banach and Hilbert spaces, best approximations, linear operators and adjoints, Frechet derivatives and nonlinear optimization, fixed points and iterative methods. Applications to control theory, mathematical programming, and numerical analysis.

718. Topics in Analysis. (3) Selected topics from functional analysis or analytic function theory.

721, 722. Abstract Algebra. (3, 3) Groups, rings, fields, extensions, Euclidean domains, polynomials, vector spaces, Galois theory.

723, 724. Seminar on Theory of Matrices. (1, 1)

725, 726. Seminar in Algebra. (1, 1)

728. Topics in Algebra. (3) Topics vary and may include algebraic coding theory, algebraic number theory, matrix theory, representation theory, non-commutative ring theory.

- 731, 732. General Topology.** (3, 3) An axiomatic development of topological spaces. Includes continuity, connectedness, compactness, separation axioms, metric spaces, convergence, embedding and metrization, function and quotient spaces, and complete metric spaces.
- 733. Topics in Topology and Geometry.** (3) Topics vary and may include knot theory, non-Euclidean geometry, combinatorial topology, differential topology, minimal surfaces and algebraic topology.
- 735, 736. Seminar on Topology.** (1, 1)
- 737, 738. Seminar on Geometry.** (1, 1)
- 744. Topics in Number Theory.** (3) Topics vary and are chosen from the areas of analytic, algebraic, and elementary number theory. Topics may include Farey fractions, the theory of partitions, Waring's problem, prime number theorem, and Dirichlet's problem.
- 745, 746. Seminar on Number Theory.** (1, 1)
- 747. Topics in Discrete Mathematics.** (3) Topics vary and may include enumerative combinatorics, graph theory, algebraic combinatorics, combinatorial optimization, coding theory, experimental designs, Ramsey theory, Polya theory, representation theory, set theory and mathematical logic.
- 748, 749. Seminar on Combinatorial Analysis.** (1, 1)
- 750. Dynamical Systems.** (3) Introduction to modern theory of dynamical systems. Linear and non-linear autonomous differential equations, invariant sets, closed orbits, Poincare maps, structural stability, center manifolds, normal forms, local bifurcations of equilibria, linear and non-linear maps, hyperbolic sets, attractors, symbolic representation, fractal dimensions. P—MTH 611.
- 752. Topics in Applied Mathematics.** (3) Topics vary and may include computational methods in differential equations, optimization methods, approximation techniques, eigenvalue problems.
- 753. Nonlinear Optimization.** (3) The problem of finding global minimums of functions is addressed in the context of problems in which many local minima exist. Numerical techniques are emphasized, including gradient descent and quasi-Newton methods. Current literature is examined and a comparison made of various techniques for both unconstrained and constrained optimization problems. Credit not allowed for both MTH 753 and CSC 753. P—MTH (or CCS) 655.
- 754. Numerical Methods for Partial Differential Equations.** (3) Numerical techniques for solving partial differential equations (including elliptic, parabolic and hyperbolic) are studied along with applications to science and engineering. Theoretical foundations are described and emphasis is placed on algorithm design and implementation using either C, FORTRAN or MATLAB. Credit not allowed for both MTH 754 and CSC 754. P—MTH 655 or CSC 655.
- 758. Topics in Statistics.** (3) Topics vary and may include linear models, nonparametric statistics, stochastic processes.
- 761. Stochastic Processes.** (3) Discrete time and continuous time Markov chains, Poisson processes, general birth and death processes, renewal theory. Applications, including general queuing models.
- 791, 792. Thesis Research.** (1-9)

Interdisciplinary Graduate Certificate Program in Medieval Studies (GCPMS)

Departments of English, Romance Languages, Religion, History, Political Science, Philosophy, Music, Classics, Art History, Divinity School, German, Humanities, Art History

Directors Gillian R. Overing and Gale Sigal

Professors Stewart Carter, Gillian Overing, Mary Pendergraft, Gale Sigal, Harry Titus, Robert Ulery, Ulrike Wiethaus

Associate Professors Bernadine Barnes, Michaelle Browers, Jefferson Holdridge, Judy Kem, Sol Miguel-Prendes, Roberta Morosini, Monique O'Connell, Olga Valbuena-Hanson, Neal Walls

Assistant Professors Patrick Toner, Charles Wilkins

Adjunct Associate Professor Darlene Rae May

The Interdisciplinary Graduate Certificate Program in Medieval Studies (GCPMS) is designed to allow MA students in English and religion to both broaden their knowledge of and focus their studies on the medieval period. The GCPMS combines programmatic interdisciplinary coursework, training in the technical skills of medieval studies, and linguistic preparation. The program offers prospective and first-year MA students a competitive advantage in admission to doctoral programs. Students may be admitted to the program by permission of the directors when they are admitted to the graduate program in the department to which they apply or at any time during their first year.

Students must complete all graduate requirements for the MA in English or religion (separately listed in this bulletin under each department) and may take undergraduate courses in any participating department towards the certificate. (A listing of courses that satisfy the medieval studies minor can be found in the *Wake Forest University Undergraduate Bulletin*.) Courses satisfying the certificate may overlap with department graduate requirements, but acquiring the certificate requires coursework beyond that of the disciplinary MA.

Students are required to take a minimum of four additional courses (12 hours) with a medieval focus; these courses should represent two different disciplinary fields in addition to that of the candidate's home department. In consultation with the program director, one or more of these additional courses may be taken as directed reading or as medieval language courses. The graduate thesis must have a medieval focus, and the thesis committee should have at least two participating departments represented.

The GCPMS generally does not require more time to complete than the host MA program in English or religion. While students working towards the GCPMS are required to take four courses in medieval studies beyond the standard requirements of the departmental MA, some of those additional courses may be taken as an overload during the academic years or during the summer. Students are strongly encouraged to apply for extramural fellowships to study one or more summers at the international sites where a medieval studies curriculum is available (e.g., St Peter's College at Oxford [see the medieval studies minor in the 2008-2009 *Wake Forest University Undergraduate Bulletin* for details]). A final mechanism is to request approval from the relevant departmental graduate committee to apply two of the courses taken toward completion for the MA degree toward the certificate program with the addition of relevant course-related materials.

Students in the GCPMS may avail themselves of many activities and opportunities including the medieval studies lecture series; the paper competition that rewards the winners with funding to the International Congress on Medieval Studies at Western Michigan University; the Gordon A. Melson Graduate Student Award in Medieval Studies, specifically awarded to an outstanding graduate student to attend

the International Congress on Medieval Studies at Western Michigan University; the medieval studies summer program at St. Peter's College, Oxford; the annual Wake Forest Medieval Studies Student Society Conference, a student-organized interdisciplinary conference inviting participation from graduates and undergraduates from surrounding universities; the medieval section of the department's library in the Archie Ammons English Department Faculty Lounge; the establishment of internships and fellowships for *La corónica: A Journal of Medieval Spanish Language, Literature and Cultural Studies* (see the website at <http://college.holycross.edu/lacoronica>), edited by Professor Sol Miguel-Prendes, a medievalist in the Romance Language department.

Microbiology and Immunology (MICR)

Bowman Gray Campus

Chair Griffith D. Parks

Professors Charles E. McCall, Steven B. Mizel, Griffith D. Parks

Associate Professors Martha Alexander-Miller, Rajendar Deora, Jason Grayson, David Ornelles, W. Edward Swords

Assistant Professors Erik Barton, Karen M. Haas, Sean D. Reid, Elizabeth Hiltbold Schwartz

The Department of Microbiology and Immunology offers a graduate program leading to the PhD degree. The program prepares students for careers in research and teaching in the fields of bacteriology, immunology, molecular biology, and virology.

In addition to completion of the core curriculum, program specific course requirements include Fundamentals of Bacteriology, Fundamentals of Immunology, and Fundamentals of Virology. In addition, in the second and third years, all students participate in the interdisciplinary, literature-based course Advanced Topics.

Students enter the program through the Molecular and Cellular Biosciences Track and participate in the MCB common curriculum in the first year. At the end of the first year, students select their research area and dissertation advisor. Students entering the program may choose to do their thesis work among the areas of bacterial and viral pathogenesis, cellular and molecular immunology, and the cell and molecular biology of the microbe-host interaction.

See the Department of Microbiology and Immunology homepage (www.wakehealth/microbio) for further information on the department and detailed descriptions of faculty research interests.

Applicants for the graduate program should have demonstrated undergraduate proficiency in biology, chemistry, and mathematics, and should also have satisfactory scores on the GRE.

The following electives are offered through the MCB Track:

MCB 731. Fundamentals of Virology. (2) Basic aspects of the structure, replication, and pathogenesis of animal viruses are taught through a mixture of lectures and discussions based on current literature. Intended for all graduate students in microbiology and immunology to provide in-depth coverage of these areas of virology.

MCB 732. Fundamentals of Bacteriology. (2) Basic aspects of bacterial structure, physiology, genetics, and pathogenesis are taught through a mixture of lectures and discussions based on the current literature. Intended for all graduate students in microbiology and immunology to provide in-depth coverage of these areas of bacteriology.

MCB 734. Fundamentals of Immunology. (2) This course focuses on the cellular, biochemical, and molecular aspects of innate, cellular and humoral immunity. Intended for all graduate students in microbiology and immunology to provide in-depth coverage of these areas of immunology.

The following advanced courses in MICR are offered:

704. Microbiology of Infectious Diseases. (3) An in-depth study of the role of microbial agents in host-parasite interactions. The course includes a survey of the basic properties of bacteria, viruses, fungi, and parasites. The pathways leading from exposure to successful infection to disease are examined. Specific examples of major pathogens and the diseases they cause are discussed in detail in the context of clinical situations employing the problem-based learning format. P—POI.

707. Scientific Methodology. (1) Instruction in the scientific method as applied to basic research in bacteriology, virology, and immunology and microbial pathogenesis. Examples from the scientific literature are used to provide practical training in effective oral communication and expository scientific writing. P—POI.

711. Tutorial in Medical Microbiology. (1-3) Guided reading and discussion of the pathogenesis of infectious diseases.

716. Practical Statistics in Microbiology and Immunology. (1) Provides a practical introduction to the application of statistical methods commonly required for studies in bacteriology, virology, and immunology. Consists of a mixture of lectures and in-class exercises based on problems drawn from current research in the department. Topics include sampling principles, descriptive statistics, parametric and non-parametric tests, one-way analysis of variance, contingency tables, linear regression, and power calculations. Emphasis is on recognizing and applying the appropriate methods. P—POI.

719, 720. Research in Microbiology. (Credit to be arranged.)

721, 722. Teacher Training. (0) Advanced graduate students give a lecture in their areas of specialization in one of the graduate courses offered by the department. P—Advanced standing.

749, 750. Advanced Topics in Microbiology and Immunology. (2) Seminar course dedicated to the analysis of current research literature on the fundamental biochemical and molecular processes involved in the growth, differentiation, and functions of bacteria, viruses, and eukaryotic cells. The course not only provides the student with experience in literature analysis, but also offers a broad exposure to timely and important themes and principles that link the disciplines of microbiology, virology, and immunology. P—biochemistry, microbiology, immunology, and virology.

Molecular and Cellular Biosciences (MCB) Track 4

Bowman Gray Campus

Director Roy Hantgan

Molecular and Cellular Biosciences (MCB) is an interdisciplinary graduate track that provides students with opportunities to choose from among over 100 mentors whose research spans basic and translational fields of cutting-edge molecular and cellular biology. Graduate programs within the MCB track enable students to earn a Ph.D. in Biochemistry and Molecular Biology, Cancer Biology, Microbiology and Immunology, Molecular Genetics and Genomics, Molecular Medicine and Translational Science, or

Molecular Pathology, as well as a Certificate in Structural and Computational Biophysics. In their first year, MCB students will complete a short course in analytical skills followed by a year-long core course that first examines macromolecular structure, synthesis and function, as well as gene expression and genetics; the second semester focuses on cell structure, cell communication, organ systems integration and physiology and pathology. MCB students will also select three program-specific electives from an array of 15 courses. They will explore a range of research opportunities by participating in three research rotations, each in a different MCB laboratory. These rotations introduce them to new techniques and guide their selection of a graduate program and dissertation research advisor; as 2nd year students they will complete program-specific requirements along their path toward a doctoral degree.

700. Analytical Skills. (1) Molecular and Cellular Biosciences students will begin their graduate education with this 1-credit course focused on data acquisition and analysis methods. Balancing theory and practice, it will refresh their mathematical skills; describe techniques for isolating and characterizing cells and their macromolecular components; explore methods for manipulating genes and performing high-throughput assays; and introduce bioinformatics approaches. A series of take-home exercises reinforce problem-based learning. MCB 700 will be offered as 10 x 1.5 h. sessions in the two weeks preceding fall term.

701. Molecular and Cellular Biosciences. (1-6) Molecular and Cellular Biosciences students will take a two-semester core course that will cover fundamental principles of the discipline. The overall goal of the course is to develop the student's understanding of molecular and cellular biosciences in the context of biomedical research as it relates to human disease. In the first semester students will focus on the basic building blocks of the cell, their synthesis, cellular metabolism and intracellular transport. The semester is broken into five blocks or themes that in order roughly cover; 1) proteins and enzymes; 2) carbohydrates and lipids; 3) DNA and microbial genetics; 4), mammalian genetics and genomics; and 5) intracellular sorting, cytoskeleton, extracellular matrix. The course is in the format of didactic lectures and meets for 6 hrs per week (four 90 minute lectures/week). Students are evaluated on the performance of 5 written exams given at the end of each block. Other Tracks may elect to have students take one or more blocks as 1 credit courses.

702. Molecular and Cellular Biosciences. (1-6) In the second semester students will focus on additional cell biological topics followed by several units devoted to integrative physiology. The semester is broken into five blocks or themes that cover 1) cell signaling, cell-cell communication; 2) cell cycle, cell death, oncogenesis, developmental and stem cell biology; 3) endocrinology and metabolic control and integration; 4) renal, gastrointestinal, cardiovascular, and respiratory physiology; and 5) microbiology and innate and acquired immunity. The course is in the format of didactic lectures and meets for 6 hours per week (four 90 minute lectures/week). Students are evaluated on the performance of 5 written exams given at the end of each block. Other Tracks may elect to have students take one or more blocks as 1 credit courses. Although not required, it is expected that students are familiar with material covered in MCB 701.

703, 704, 705. Introduction to Molecular and Cellular Biosciences Research. (1) Molecular and Cellular Bioscience students will gain experience with the planning and execution of research, and the interpretation and presentation of experimental results. To put these principles into practice, they will carry out mentored research projects in the laboratories of three different Molecular and Cellular Biosciences faculty members. Graded as Satisfactory/Unsatisfactory.

711. Biological Systems and Structures. (2) In depth study of macromolecular assembly and interactions, as well as the application of structural biology and proteomics technology. Contemporary concepts of the principles of protein and nucleic acid structure will be presented. Other topics include methods for structure determination such as X-ray diffraction, NMR spectrometry, and molecular modeling.

712. Biological Spectroscopy. (2) Principles and practicalities of the study of biomolecules using spectroscopic techniques such as absorbance, fluorescence and circular dichroism analyses will be covered. Other biophysical approaches such as mass spectrometry and sedimentation analysis will be included. Topics in the study of enzymes utilizing these techniques will be discussed.

713. Large Experimental Datasets and Analysis. (2) Conducted as a combination of lectures, reading assignments, and student-led discussions. Lectures detail experimental methods that generate large-scale datasets. Topics will include genotyping, expression profiling, metabolomics, high-content cellular imaging techniques and practical examples of bioinformatic software and statistic analyses.

714. Experimental Approaches to Cell Biology and Disease. (2) Conducted as a combination of lectures, reading assignments, and student-led discussions. With an emphasis on cellular functions involved in disease, lectures detail common techniques used in cell biology experimentation. Practical examples and issues of functional genomic approaches are discussed, including design of appropriate cell biology models.

721. Carcinogenesis, DNA Damage and Repair. (2) This course will cover the identification and reaction mechanisms of environmental carcinogens, DNA damage and mutagenesis by endogenous and exogenous agents, and the mechanisms of DNA repair.

722. Molecular Pathogenesis of Cancer. (2) Fundamental molecular changes in cells and tissues that contribute to the malignant phenotype are discussed. Topics include alterations in genes and chromatin, signaling pathways, tumor cell metabolism, and the tumor microenvironment.

723. Topics in Cancer Biology. (2) Teaches students how to evaluate and communicate scientifically in the area of cell biology and cancer. Examples are taken from all areas of cancer in this advanced course. Uses current peer-reviewed journal articles to teach fundamental concepts and act as a medium for allowing the students to communicate ideas with an emphasis on presentation skills.

731. Fundamentals of Virology. (2) Basic aspects of the structure, replication, and pathogenesis of animal viruses are taught through a mixture of lectures and discussions based on current literature. Intended for all graduate students in microbiology and immunology to provide in-depth coverage of these areas of virology.

732. Fundamentals of Bacteriology. (2) Basic aspects of bacterial structure, physiology, genetics, and pathogenesis are taught through a mixture of lectures and discussions based on the current literature. Intended for all graduate students in microbiology and immunology to provide in-depth coverage of these areas of bacteriology.

734. Fundamentals of Immunology. (2) This course focuses on the cellular, biochemical, and molecular aspects of innate, cellular and humoral immunity. Intended for all graduate students in microbiology and immunology to provide in-depth coverage of these areas of immunology.

741. Computational Biology. (2) An introduction to the use of software and resources available for analysis of genes and proteins. Students will learn how to use practical tools to analyze protein and gene sequences through a combination of lectures and completion of hands-on problem sets.

742. Molecular Genetics and Genomics of Human Disease. (2) This course will introduce students to applications of molecular genetic and genomic methods for the identification and functional characterization of genes contributing to human disease. In addition, complementary lectures will address the application of cell and animal model systems and methods which provide functional insights into the mechanism of action of genes that contribute to disease.

752. Foundations of Translational Science. (2) Builds on the student's basic biochemistry and cell biology knowledge with an intensive examination of the molecular basis of human disease and its' treatment. The course mixes lectures with a case-based approach to take students through the diagnosis, physiology, pathophysiology, and the molecular mechanisms of several diseases. Learning issues are developed by the group, centered upon treatment options, their mechanisms of action, the appropriate design of clinical trials to test new therapies, and the research base for further advances in prevention and treatment. MD and PhD facilitators assist with student-led discussions. Relevant, current literature is examined.

753. Introduction to Regenerative Medicine. (2) The course will address fundamental principles and progress in regenerative medicine (RM) and tissue engineering (TE) research in recent years. RM integrates the fundamentals of cell and molecular biology, materials science, biomedical engineering, and clinical science. The goal of RM and TE is to develop materials and therapies to repair or replace cells, tissues, and organs damaged by disease, trauma, or congenital conditions. Successful clinical translation of TE/RM therapies requires the expertise of scientists, engineers and clinicians. The main topics discussed during the course will include cell sources and biomaterials for RM and TE, cellular therapies, strategies for gene therapy and animal models, as well as ethical and regulatory issues. In addition the course will consider issues relevant to stem cell biology, biomaterials selection and evaluation of functional tissue formation and healing. Students will be required to prepare and present a research summary of an RM and TE application.

761. Pathobiology of Atherosclerosis and Cardiovascular Disease. (2) This lecture course explores the pathogenic mechanisms that underlie this most prevalent of human diseases. Provides an overview of the current concepts of the pathogenesis of atherosclerosis and its clinical sequelae, myocardial infarction, stroke, and peripheral vascular disease. Specific topics include the natural history of atherosclerosis, experimental approaches for the study of atherosclerosis and cardiovascular disease (cell and animal models, featuring genetically-modified mouse models), metabolic perturbations underlying disease initiation, progression, and regression, lipid metabolism and dyslipidemias, diabetes, diet and obesity, hypertension, behavioral factors, vascular wall biology (including new imaging techniques) and treatment of cardiovascular disease. A unique feature of the course is its integration of basic, clinical, and translational research. The focus on current research directions provides an excellent foundation for students interested in atherosclerosis, lipid metabolism, vascular biology, and cardiovascular disease as they plan their own research careers. It should also be of interest to students in other areas of translational medicine.

762. Lipid Metabolism and Chronic Human Disease. (2) This is an introductory course designed to cover basic concepts of lipid metabolism and its relationship to the development of chronic human diseases. The first half of the course will cover lipid structure and properties and lipid absorption, transport, synthesis, storage and mobilization from tissues, and degradation. The role of lipids in cell signaling and innate/acquired immunity will also be discussed. The second half of the course will explore the role of lipid metabolism in monogenetic disorders and in the pathogenesis of chronic human diseases, such as atherosclerosis, insulin resistance, obesity and metabolic syndrome. Current research in Lipid Sciences and Chronic diseases will also be covered.

Molecular Pathology (PATH)

Bowman Gray Campus, Friedberg Campus, Piedmont Triad Research Park

Pathology

Director John S. Parks

Professors Thomas B. Clarkson, J. Mark Cline, Paul A. Dawson, Steven Feldman, A. Julian Garvin, Jay R. Kaplan, Nancy Kock, John S. Parks, Lawrence L. Rudel, Gregory S. Shelness, Carol A. Shively, Mary Sorci-Thomas, Janice D. Wagner, Mark C. Willingham

Professor Emeritus Michael R. Adams, Richard W. St. Clair

Associate Professors Zheng Cui, Iris J. Edwards, Timothy Kute, Thomas C. Register

Assistant Professors J. Mark Brown, Purnima Dubey, Kazushi Inoue, Kylie Kavanagh, Ryan E. Temel

Instructor Xuewei Zhu

Associate Faculty from other Departments Floyd H.(Ski) Chilton, Randolph L. Geary, Nilamadhab Mishra, Richard B. Weinberg

Molecular Pathology was the first interdisciplinary graduate program leading to the PhD degree at Wake Forest University and is offered by the Department of Pathology. The course of study and research are designed for students who wish to prepare for a career of research and/or teaching in pathobiology, the study of fundamental mechanisms of disease processes. Students enter the program through the Molecular and Cellular Biosciences (MCB) Track and participate in the MCB curriculum in the first year. By means of coursework, seminars, and journal clubs, the student is given a firm background in the basic medical sciences, including pathology, cell biology, molecular biology, biochemistry, physiology, and statistics. Advanced coursework is designed to fit the interests of the individual student, and disciplinary strength may be developed in molecular, cellular, biochemical, metabolic, comparative, or morphologic aspects of disease processes. Experimental design, the use of modern techniques and procedures, and interpretation of experimental results are stressed.

Research opportunities are available in the areas of cell and molecular biology, including gene discovery and translational genetics; macrophage cell biology; cancer biology; lipid and lipoprotein metabolism; arteriosclerosis; diabetes; obesity; inflammation and chronic diseases; osteoporosis; nutrition; reproductive biology; nonhuman primate behavior; comparative genetics; and diseases of laboratory animals. Research is particularly strong in the area of cardiovascular disease, chiefly arteriosclerosis, with emphasis on the use of transgenic animals and nonhuman primates as animal models for this disease.

The program is open to qualified applicants with the BS or BA degree and a strong background in the physical and biological sciences, including organic chemistry. In addition, the program is open to applicants holding the MD or DVM degree who desire an advanced degree to prepare them for careers in research. The PhD program began in 1969.

The following electives are offered through the MCB Track.

MCB 761. Pathobiology of Atherosclerosis and Cardiovascular Disease. (2) This lecture course explores the mechanisms that underlie atherosclerotic cardiovascular disease, the leading cause of death in the United States and other industrialized countries. It provides an overview of current concepts of the pathogenesis of atherosclerosis and its clinical sequelae, including myocardial infarction, stroke, and peripheral vascular disease. Specific topics include the natural history of atherosclerosis, experimental

approaches for the study of cardiovascular disease (cell and animal models, featuring non-human primates and genetically-modified mouse models), and metabolic perturbations underlying disease initiation, progression, and regression. Risk factors and treatments for cardiovascular disease are also discussed. A unique feature of the course is its integration of basic and clinical concepts, which should benefit students interested in translational aspects of cardiovascular disease research.

MCB 762. Lipid Metabolism and Chronic Human Diseases. (2) This is an introductory course designed to cover basic concepts in lipid metabolism and its relationship to the development of chronic human diseases. The first half of the course will review the structure and biophysical properties of lipids, as well as mechanisms of lipid absorption, transport, synthesis, catabolism, storage, and mobilization from tissues. The role of lipids in cell signaling and innate/acquired immunity will also be discussed. The second half of the course will explore the role of lipid metabolism in monogenic disorders and in the pathogenesis of chronic human diseases, such as atherosclerosis, insulin resistance, obesity and metabolic syndrome. Current research in Lipid Sciences and Chronic diseases will also be covered.

The following advanced courses in PATH are offered.

702. Fundamentals of Pathology. (3) Introduction to the principles of disease with special emphasis on mechanisms of cellular and tissue responses. The first portion of the course deals with methods of study; cellular pathobiology and mechanisms of inflammatory response; and genetic, immune and infectious disorders. The second portion is concerned with disorders of cellular differentiation and growth, disorders of circulation, metabolic disorders and aging. Exposure to human gross pathology is provided during the course. P—Histology or POI.

706. Animal Models in Biomedical Research. (3) See Comparative Medicine.

709, 710. Advanced Topics in Comparative Medicine. See Comparative Medicine.

715, 716. Advanced Topics in Pathology. (1-5) Advanced lecture and student participation course dealing with areas of new knowledge in pathobiology. Course content may change with recent advances in knowledge. Four semesters may be taken for credit. P—PATH 702, COMD 703, or POI.

719. Research Techniques in Microscopy. (3) Introductory course designed to develop skill in the use of microscopy in biomedical research. The basic lab-oriented, hands-on program provides the opportunity to develop proficiency in operation of light, video, confocal, and electron microscopes. Labs are supplemented with a lecture series introducing major research applications such as histo- and cytochemistry, digital image processing and analysis, quantitative microscopy, and 3-D microscopy. The final project requires students to apply microscopy techniques to their research interests. Class is limited to eight students with a preference for students after their first year of graduate school.

721, 722. Select Topics in Microscopy. (1-3) Lab-based independent study course to develop specialized practical knowledge in the use of a select research technique such as autoradiography, histo- or cytochemistry, whole-mount (3-D) microscopy, replica techniques, or morphometry. This student-initiated, individualized study is designed to meet specific research and educational needs. P—PATH 719 or POI.

724. Scientific Development and the Business of Science. (3) Review of techniques for effective communication of scientific proposals and presentations, both oral and written. For oral presentations, emphasis is on content organization and connecting with the audience. Assignments include the presentation and critical discussion of papers by the students. For written presentations, the emphasis is on grant

proposal development, as well as familiarization with the peer-review process. The course consists of lectures on all aspects of grant development (including budgets and protocols and compliance regulations for human and animal research), and student preparation of a grant proposal. An oral exercise includes the discussion of an NIH RO1 proposal in a mock study section format. Also listed as MMTS 724 P—POI.

727, 728. Molecular Pathology Seminar. (1,1) Seminars on topics of current interest are offered weekly by graduate students, staff, and visiting lecturers.

729, 730. Research. Research opportunities are available in molecular and cellular pathobiology projects conducted in the Department of Pathology.

Molecular Genetics and Genomics (MOGN)

Bowman Gray Campus

Director Mark O. Lively

Professors Steven A. Akman, Colin E. Bishop, Donald W. Bowden, H. Alexander Claiborne, Yong Q. Chen, Martin K. Childers, George J. Christ, Paul A. Dawson, Waldemar Debinski, Jacquelyn Fetrow, Barry I. Freedman, William H. Gmeiner, Scott E. Hemby, Ross P. Holmes, Daniel B. Kim-Shapiro, Mark O. Lively, Douglas S. Lyles, Charles E. McCall, Deborah A. Meyers, Mark S. Miller, Carol E. Milligan, Steven B. Mizel, Charles S. Morrow, Gloria K. Muday, Barbara J. Nicklas, Ronald W. Oppenheim, Griffith D. Parks, John S. Parks, Fred W. Perrino, Mark J. Pettenati, Leslie B. Poole, Gregory S. Shelness, Peter B. Smith, Beverly M. Snively, Shay Soker, Mary G. Sorci-Thomas, Ann Tallant, Suzy V. Torti, Alan J. Townsend, Richard B. Weinberg, Jianfeng Xu

Associate Professors Martha A. Alexander-Miller, Rebecca W. Alexander, Zheng Cui, Rajendar Deora, Roy R. Hantgan, Gregory A. Hawkins, Ashok N. Hegde, Thomas Hollis, David A. Horita, Timothy D. Howard, Fang-Chi Hsu, Steven J. Kridel, Yongmei Liu, W. Todd Lowther, Lance D. Miller, Nilamadhab Mishra, David A. Ornelles, Thomas C. Register, Paul D. Savage, W. Edward Swords, Yuh-Hwa Wang, James Yoo

Assistant Professors Peter A. Antinozzi, Elizabeth Hiltbold Schwartz, Akiva Mintz, Chor Yin Ng, Timothy S. Pardee, Derek Parsonage, Jieli Sun, Mark E. Van Dyke, Stephen J. Walker, John C. Wilkinson, Bingzhong Xue, Liqing Yu

The graduate training program in Molecular Genetics and Genomics is an interdisciplinary curriculum that leads to the Ph.D. degree in Molecular Genetics and Genomics. The major goal of the program is to train students for independent research and teaching in the fields of laboratory molecular and cellular biology or computational analysis in genetics and genomics. The program faculty has departmental affiliations in all of the basic science departments and several clinical departments of the Medical School, and departments on the Reynolda Campus. There are two program tracks:

- **The Laboratory Sciences program of study** is designed to provide a firm background in the basics of molecular and cellular biology, while also providing advanced course work designed to meet the objectives of the student and the laboratory in which the student performs his/her dissertation research.

- **The Analytical Sciences program of study** is designed to provide strong background in analysis using bioinformatics and statistics and also providing advanced course work designed to meet the objectives of the student and their thesis advisor. By its nature this program has more extensive didactic coursework requirements.

The Graduate Program in Molecular Genetics and Genomics provides specialized training in the field of Molecular Genetics and Genomics while integrating student training as much as possible with traditional departmental disciplines. Students may elect to pursue this program of study after successful completion of the first year common curriculum of the Molecular and Cellular Biosciences (MCB) Track.

The program accepts students with a variety of undergraduate degrees including majors in the biological sciences, chemistry, mathematics, computer science and statistics. Applicants for the Laboratory Sciences program have usually successfully completed courses in general biology, general chemistry, organic chemistry, physics, statistics, and mathematics through calculus. Analytical Sciences program applicants will have successfully completed advanced courses in mathematics, statistics, and/or computer science. Students in Analytical Sciences are strongly recommended to have some preparation in basic chemistry and life sciences.

During the second year, students begin research in their dissertation laboratory and take specialty courses relevant to the area of research conducted in that laboratory. Second-year courses include the advanced seminar-style courses, 741 and 742. Dissertation research is performed under the supervision of a program faculty member and is tailored to meet the interests and training objectives of the individual student.

The following electives are offered through the MCB Track:

MCB 741. Computational Biology. (2) An introduction to the use of software and resources available for analysis of genes and proteins. Students will learn how to use practical tools to analyze protein and gene sequences through a combination of lectures and completion of hands-on problem sets.

MCB 742. Molecular Genetics and Genomics of Human Disease. (2) Introduces students to applications of molecular genetic and genomic methods for the identification and functional characterization of genes contributing to human disease. In addition, complementary lectures address the application of cell and animal model systems and methods which provide functional insights into the mechanism of action of genes that contribute to disease.

The following advanced course in MOGN are offered:

701, 702. Research in Molecular Genetics. (1-9) Research investigations in molecular genetics are conducted in the laboratories of program members studying a wide range of disciplines.

710. Scientific Writing. (1) Designed to provide training in the preparation of scientific papers for publication, preparation of research proposals, and discussions of ethical conduct of scientific research. P—POI.

719, 720. Special Topics in Stem Cell Biology. (2) Utilizes directed readings and student presentations of primary literature to introduce students to the field of stem cell biology. Content focuses primarily on human stem cell properties, including pluripotency and its maintenance, the role of chromatin remodeling in fate determination and lineage restriction, self-renewal and differentiation, and the genetic conversion of somatic cells into pluripotent stem cells. The field is expanding rapidly and course content will be modified as needed to incorporate new findings and applications in stem cell

biology and translational medicine. A background in the form of undergraduate or graduate courses in and/or developmental biology is strongly recommended. Also listed as MMTS 719, 720. P—POI.

726. Genetic Epidemiology. (2) Presents fundamental concepts and methods in genetic epidemiology. Introduces various genetic epidemiology study designs in related and unrelated individuals and covers basic analysis, inferences, plus their strengths and limitations. Lecture and lab. P—MCB 701, CPTS 720; CPTS 730, or POI.

734. Human Molecular Genetics. (2) A combined lecture/seminar course providing an overview of current theoretical and technical approaches for locating, identifying, and cloning human genes using molecular genetic methods. Emphasis is on the search for genes that contribute to simple single-gene disorders and common complex diseases. Topics include genetic mapping and association studies, chromosome structure at the molecular level, identification of coding sequences and disease susceptibility genes, and functional analysis of gene products. P—MCB 701 or POI.

741, 742. Tutorials in Molecular Biology. (2, 2) Seminar course that focuses on new and important aspects of research in molecular and cellular biology with an emphasis on the current literature. Each semester the course explores specific themes chosen by a committee of faculty and students. Students select topics for presentation and lead discussions with faculty and graduate students.

751. Medical Genetics. (3) Introduction to the principles and clinical evaluation of human genetic diseases. Covers modes of inheritance, etiology, characteristics, epidemiology, pathogenesis and clinical features of a wide variety of medical genetic disorders. Procedures for diagnostic confirmation (cytogenetic, molecular, biochemical), considerations in management and aspects of genetic counseling is presented.

Molecular Medicine and Translational Science (MMTS)

Bowman Gray Campus

Director K. Bridget Brosnihan and **Co-Director** Richard Loeser

The graduate program in Molecular Medicine and Translational Science, an interdisciplinary program offering the PhD and MS degrees, is specifically designed to meet the challenge of training basic scientists to function successfully in clinical environments. The last decade has brought about fundamental and radical advances in a number of disciplines including biochemistry, cellular and molecular biology, and immunology. These changes have led to unparalleled opportunities to advance medical research and patient care. Both basic and clinical scientists can now test novel and provocative hypotheses using tools such as recombinant DNA technologies, functional imaging techniques, mass spectrometry, and monoclonal antibody therapy and quickly acquire results that would have seemed fanciful science fiction only a few years ago. These new approaches have not only made it possible to understand cellular and molecular mechanisms of human disease, but they also offer the promise of new and revolutionary therapeutic options for clinicians.

Translating new advances in science to improved bedside care for patients requires erasing many of the historical divisions between basic and clinical scientists. For modern-day clinicians to understand and take advantage of new developments, a great deal of time must be spent at both the bedside and the bench. Conversely, the potential to understand mechanisms of illness and its treatment brings relevance and urgency to the work of basic scientists, moving them closer to their clinical colleagues. This movement into the clinical arena facilitates the challenge of viewing a complex clinical disorder through the eyes of

the basic scientist. For these reasons, there has been a major emphasis by national, private, and industrial granting organizations to fund basic research that has the potential to immediately impact human disease. This creates a unique niche for basic (PhD) scientists who are trained on the cutting edge of molecular advances to perform “translational” research in human biology and disease.

The molecular medicine and translational science program provides training in the use of cellular, molecular, and integrative approaches to investigate biologic events with an emphasis on human disease. The multidisciplinary faculty consists of scientists who have major ongoing human research programs. The program offers PhD students a comprehensive knowledge of human biology and disease that allows them to develop basic research programs with fundamental clinical implications. It is also designed to train biomedical researchers to fill an important niche in academia or industry.

For MD- or DO-trained physician-scientists on faculty or in training at Wake Forest University Baptist Medical Center, a master's or PhD degree in molecular medicine is also available for qualified candidates. The overall objective of the MS/PhD program is to train individuals who already hold an MD degree in the cellular and molecular techniques needed to integrate basic science with clinical applications involving human disease. An additional benefit of the program is that it enhances interaction between MDs in clinical departments and PhDs who are engaged in fundamental bench research focused on human disease.

For more information regarding the PhD or MS degree programs in molecular medicine and translational science visit our homepage, www.wakehealth.edu/School/Molecular-Medicine-Graduate-Program/Molecular-Medicine-Graduate-Programs.htm. The MMTS program participates in the Molecular and Cellular Biosciences (MCB) PhD track. Prospective students interested in MMTS apply to the MCB track and can indicate their interest in the MMTS program on the application. Applicants to the MCB Program should have a solid background in biological and/or physical sciences, prior research experience and a passion for scientific inquiry. Students enter the program through the Molecular and Cellular Biosciences Track and participate in the MCB common curriculum in the first year. Curriculum in subsequent years includes participation in Translational Science Seminar Series, Clinical Experience, Foundations of Translational Science, Scientific Development and Business of Science course, and electives of the student's choice.

Prospective students are encouraged to contact individual faculty members whose research is of particular interest. MS applicants to the MMTS program will not be considered if they do not already hold a faculty position at the Wake Forest University School of Medicine.

The following electives are offered through the MCB track:

MCB 752. Foundations of Translational Science. (2) Builds on the student's basic biochemistry and cell biology knowledge with an intensive examination of the molecular basis of human disease and its treatment. The course mixes lectures with a case-based approach to take students through the diagnosis, physiology, pathophysiology, and the molecular mechanisms of several diseases. Learning issues are developed by the group, centered upon treatment options, their mechanisms of action, the appropriate design of clinical trials to test new therapies, and the research base for further advances in prevention and treatment. MD and PhD facilitators assist with student-led discussions. Relevant, current literature is examined.

MCB 753. Introduction to Regenerative Medicine. (2) The course will address fundamental principles and progress in regenerative medicine (RM) and tissue engineering (TE) research in recent years. RM integrates the fundamentals of cell and molecular biology, materials science, biomedical engineering, and clinical science. The goal of RM and TE is to develop materials and therapies to repair or replace cells, tissues, and organs damaged by disease, trauma, or congenital conditions. Successful

clinical translation of TE/RM therapies requires the expertise of scientists, engineers and clinicians. The main topics discussed during the course will include cell sources and biomaterials for RM and TE, cellular therapies, strategies for gene therapy and animal models, as well as ethical and regulatory issues. In addition the course will consider issues relevant to stem cell biology, biomaterials selection and evaluation of functional tissue formation and healing. Students will be required to prepare and pre-sent a research summary of an RM and TE application.

The following advanced courses in MMTS are offered:

700, 701. Scientific Communication. (1,1) See Biochemistry and Molecular Biology.

711, 712. Translational Science Seminar Series. (1, 1) Faculty and students jointly describe their research in a human disease, first in clinical terms and then to follow the development of the understanding of that disease to the molecular level with an emphasis on translational applications. Presentations introduce students to potential preceptors and experimental strategies used to study human disease. Students present their own research to gain experience and professional skills for seminars and national meeting presentations.

715. Clinical Experience. (3) Serves as an introduction to clinical medicine for the PhD student. Students are required to round with medicine and pediatric teams in the intensive care units and to observe pediatric and internal medicine outpatient clinics. Students observe in several clinical laboratory settings. Students observe and interact with members of the health care team in medical decision-making and serve as a source of basic science information to the medical team. P—POI.

Choice of one of the following statistics courses.

HES 721. Data Analysis and Interpretation. (3) See Health and Exercise Science.

CPTS 730. Introduction to Statistics. (4) See Clinical and Population Translational Sciences.

IPP 741. Quantitative Methods in Behavioral Science. (2)

724. Scientific Development and the Business of Science. (3) Review of techniques for effective communication of scientific proposals and presentations, both oral and written. For oral presentations, emphasis is on content organization and connecting with the audience. Assignments include the presentation and critical discussion of papers by the students. For written presentations, the emphasis is on grant proposal development, as well as familiarization with the peer-review process. The course consists of lectures on all aspects of grant development (including budgets and protocols and compliance regulations for human and animal research), and student preparation of a grant proposal. An oral exercise includes the discussion of an NIH RO1 proposal in a mock study section format. Also listed as PATH 724. P—POI.

791, 792. Research. (1-9) Involves closely supervised research in various topics in molecular medicine, with a special emphasis on models of human disease, including research in preparation for the doctoral dissertation.

752. Foundations of Translational Science. (2) See Molecular and Cellular Bioscience. Required if not taken in the first year.

Additional Courses.

In addition to the required courses, students in the PhD program may select, in consultation with their advisor, two or more graduate-level science courses. Students should complete these additional courses prior to the end of their third year.

The following Wake Forest University programs offer graduate-level courses that meet this requirement: biochemistry and molecular biology, biology, biomedical engineering, cancer biology, chemistry, comparative medicine, health and exercise science, mathematics, microbiology and immunology, molecular pathology, neuroscience, physics, integrative physiology and pharmacology.

719, 720. Special Topics in Stem Cell Biology. (2) Utilizes directed readings and student presentations of primary literature to introduce students to the field of stem cell biology. Content focuses primarily on human stem cell properties, including pluripotency and its maintenance, the role of chromatin remodeling in fate determination and lineage restriction, self-renewal and differentiation, and the genetic conversion of somatic cells into pluripotent stem cells. The field is expanding rapidly and course content will be modified as needed to incorporate new findings and applications in stem cell biology and translational medicine. A background in the form of undergraduate or graduate courses in and/or developmental biology is strongly recommended. Also listed as MOGN 719, 720. P—POI.

Neuroscience (NEUR) Track 6

Bowman Gray and Reynolda Campuses

Director Ronald W. Oppenheim

The program is composed of over 60 research faculty and 30 clinical faculty representing fourteen basic science and clinical departments. The program offers a PhD degree in neuroscience to students interested in a research and teaching career in all areas of neurobiology. All students are required to take a core curriculum of neuroscience courses over the first three semesters as well as coursework in statistics and experimental design. During the first year of graduate study, students obtain hands-on research experience by participating in laboratory rotations. Additional graduate coursework is tailored to meet the individual needs of each student. A major goal of the program is the development of neuroscientists with a broad background in cellular, molecular and systems neuroscience with specialized skills in a specific sub-area of neurobiology.

Areas of faculty research expertise include: cellular and molecular neurobiology; developmental neurobiology; epilepsy; learning and plasticity; nerve growth and regeneration; neural basis of memory; neurobiology of aging; neurobiology of drug abuse; and neurodegenerative diseases.

As a major center of neuroscience research, the University has modern research facilities that cover all areas of contemporary neurobiological investigation, from gene cloning, genomics, and molecular genetics to electrophysiology, cell biology, and behavioral analysis. The PhD program began in 1989 and has graduated 55 students. There are currently 30 students in the program. For more information, visit our homepage at www1.wfubmc.edu/neuroscience. Prospective students are encouraged to contact individual neuroscience faculty members.

Applicants to the neuroscience graduate program should have demonstrated proficiency in biology, chemistry, physics, and mathematics with emphasis on coursework in cell and molecular biology, organic and inorganic chemistry, biochemistry, and statistics. Research experience although not required, is highly desirable.

First-year Courses

701. Introduction to Neuroscience I. (2-5) Neuroscience I is the first in a required two-course series for first-year neuroscience graduate students covering basic topics in the neurosciences. Neuroscience I is

offered only in the fall semester and deals with neuroanatomy (6 weeks), cellular and molecular neuroscience (six weeks), and developmental neuroscience (3 weeks). Approximately one third of the course includes laboratory work in neuroanatomy. For non-Neuroscience students, the neuroanatomy block may be taken separately as a two-credit course, and the cellular and molecular neuroscience block may be taken separately as a two-credit course.

702. Introduction to Neuroscience II. (2-5) Neuroscience II is the second in the series of required courses for first-year neuroscience graduate students covering basic topics in the neurosciences. Topics covered include: developmental neuroscience (3 weeks), sensory (six weeks) and motor systems (6 weeks). Cognitive and computational neuroscience are also covered. For non-Neuroscience students, the sensory block may be taken separately as a two-credit course, and the motor systems block may be taken separately as a two-credit course.

703, 704. Seminars in Neuroscience. (1) This will be a weekly seminar given by students, postdocs, faculty and external speakers. It will run throughout the year and will be structured so that each student will present a research seminar in a given year. First –third year students will give a 30-minute seminar and senior students will give an hour seminar. First year students will be assigned seminar slots during the summer between first and second year. The remaining slots will be used by postdocs and faculty. Once a month or bi-monthly, there will be an external speaker. Departments and the WNCsfn Chapter will take turns sponsoring the seminars by external speakers. Students will be required to maintain a seminar notebook.

705, 706. Tutorial in Neuroscience. (0) The Tutorial in Neuroscience will run during the spring and fall semesters. The format is one in which a faculty member or postdoc presents his/her research and a student presents a paper on a topic related to that research. It will be a required course for first- and second-year students, but will be open to all students.

707, 708. Research. (1-9) Lab research in all areas of modern neurobiology, including studies done as part of the first-year research rotations and the requirements for the doctoral dissertation.

741. Quantitative Methods in Behavioral Science. (2) Addresses applied statistical approaches within common behavioral research studies. Focus is on selection of the most appropriate test for research aims and hypotheses as well as computational methods. Specific topics include power analyses, effect sizes, analyses of variance, t tests, correlation, regression, nonparametric tests, chi square, and post hoc testing. Also listed as IPP 741.

Upper-level courses

Behavioral Neuroscience

714. Behavioral Neuroscience. (3). Behavioral neuroscience is a relatively new and rapidly expanding discipline utilizing techniques of molecular biology, neurochemistry, neurophysiology, and psychology to investigate the neurobiological basis of behavior. A broad overview of the field and its relationship to these individual disciplines is presented. The course provides a survey of the field from the cellular level to the complexity of molar aspects of behavior including learning and memory. An introduction to lab models of human neurobiological disorders is included.

722. Behavioral Pharmacology. (3) Focuses on behavioral factors that influence the effects of drugs. Material presented provides a detailed review of the rate-dependent, reinforcing, and stimulating effects of drugs. Additional topics include behavioral factors related to tolerance and sensitization and a review of animal models of drug action. Instructor:

See also:

PSY 623; BIO 623 Animal Behavior. (3) Survey of laboratory and field research on animal behavior.

BIO 624. Hormones and Behavior. (3) Introduction to the hormonal regulation of behavior in a broad range of animals, including humans and invertebrates. Topics include reproductive behavior, parental behavior, social behavior, sex differences, aggressive behavior, stress, mood, and the regulations of molting in insects.

BIO 625. Chronobiology. (3) Introduction to the field of biological rhythms, covering different types of rhythms, their evolution, and the mechanisms by which such rhythms are generated and regulated at the molecular, cellular, and system levels.

Cell and Molecular Neuroscience

721. Molecular Neuroscience. (3) Introduces graduate and advanced undergraduate students to the basic principles of neurobiology as studied by cell and molecular biologists. Lectures introduce invertebrate and vertebrate model neuronal systems and the cellular and molecular methods to study them. P—POI.

See also:

MMTS, MOGN 719. Special Topics in Stem Cell Biology. (3) Utilizes directed reading assignments from the primary literature and student presentation of seminal papers to introduce students to the field of Stem Cell Biology and the underlying biology of stem cell properties. Content will focus primarily on human stem cells and will include, but will not be limited to, pluripotency and its maintenance, the role of chromatin remodeling in fate determination and lineage restriction, self-renewal and differentiation, and genetically induced pluripotent stem cells derived from somatic cells. The field is expanding rapidly and the content will be modified as needed to incorporate new findings and developing applications in translational medicine. P—POI.

Cognitive Neuroscience

See also:

PSY 629. Perception. (3) How we perceive the world differs from what exists in reality. The study of Perception examines these discrepancies and how the psychological world relates to the physical world as indicated by the formal title “psycho-physics”. This course will explore the principles that underlie how psychologists study the processes of the senses. It will focus on three main issues: (1) the philosophical problems that underlie the mind-body problem, (2) the physiological mechanisms that determine how the body works, and (3) the perceptual mechanisms that demonstrate how the mind interprets the world.

PSY 728. Human Cognition. (3) This is a graduate course in cognitive psychology, cognitive neuropsychology, and cognitive neuroscience in which we will review what we currently know, or think we know, about human cognition and its underlying neural basis. The course will focus on characterizing components of cognition such as attention, memory, language, and perception in terms of their functional properties and in terms of how they are instantiated in the brain.

Development and Aging of the Nervous System

742. Developmental Neurobiology I: Molecular Control of Neural Lineages and Differentiation. (3) Designed as an introduction to principles of early neural development. Topics include both the genetic and epigenetic control of early developmental events, including the determination of neuronal and

glial cell lineages, expression of homeotic genes and neural pattern formation, inductive signal events required for neuronal differentiation and migration in both the central and peripheral nervous system, and the role of the extracellular environment in axonal growth. Students examine both historical and current models of molecular mechanisms regulating neural development through prescribed readings, tutorials and interactive discussion sessions. A weekly hands-on tutorial introduces students to a variety of cellular and molecular methods including mRNA analysis (mRNA purification, electrophoresis and Northern blot analysis, Rnase protection assays, RT-PCR analysis, cryostat sectioning, in situ hybridization) and protein analysis (protein polyacrylamide gel electrophoresis—PAGE, Western blot analysis, Immunoassays and Immunocytochemistry).

743. Developmental Neurobiology II: Progressive and Regressive Events in Neural Development. (3) Emphasizes regressive and progressive events required for the maturation of neural systems. Topics include molecular mechanisms of regulating both normal and pathological cell death in neurons and glia, including extracellular signals, receptors and intracellular pathways promoting or preventing cell death. Also included are topics concerning the development, specificity and pruning of synaptic connections in neural networks, as well as the role of cell adhesion and extracellular matrix in the formation of neural networks. Students examine both historical and current molecular models of cell death, neurotrophism, neurotrophic factors and their receptors. A weekly hands-on tutorial introduces students to a variety of cellular and molecular methods including in vitro methods of analysis (explant and dissociated neuronal cell culture assays for studies of cell death and axonal growth) and in vitro methods (quantitative analysis of cell death including fluorescent, histological and TUNNEL labeling of cell death, methods of axonal and dendritic labeling and EM ultrastructural analysis of synaptic changes).

744. Developmental Neurobiology III: Neural Plasticity and Regeneration. (3) Focuses on the capacity of neural networks to be modified by experience or to be reconstructed after injury. Examines molecular mechanisms proposed for activity-dependent competition in the initial construction of the nervous system, the plasticity of connections in models of activity-mediated sprouting, mechanisms proposed for neural plasticity in learning and memory, and a comparison of events required for neuronal repair and regeneration in the PNS and CNS. Current attempts to utilize neural transplantation to enhance the recovery of function in models of neurological diseases and trauma are also reviewed. Students examine both historical and current models of neural plasticity and regeneration through prescribed readings, tutorials and interactive discussion sessions.

See also:

BIO 652. Developmental Neuroscience. (4) Focuses on the development of neural structures and the plasticity of the mature nervous system. Special attention is given to experimental model systems, particularly *Drosophila melanogaster*. The labs feature molecular, immunocytochemical, and cell culture techniques for studying neurons.

Sensory Neuroscience

753. Sensory Neuroscience I: Visual and Auditory Systems. (3) This course is designed to introduce students to sensory neurobiology of visual, auditory, olfactory and gustatory systems from the cellular to systems level. Under each sensory system, the topics cover the receptors in the sensory organs, signal transduction, subcortical and cortical areas and higher order processing. The course also includes topics relevant to sensory perception such as attention, working memory, decision making and plasticity. The course is structured to enable the students to learn how individual sensory systems function and to recognize the parallels between sensory systems.

754. Sensory Neuroscience II: Somatosensation and Multi-sensory Integration. (3) This course is the second in a series that focuses on mammalian sensory systems. The course is designed to introduce students to somatosensory, pain and multisensory processing from the molecular to the systems level. The aim is to introduce key concepts of global organization that transcend individual modalities. Cellular, molecular, behavioral and pharmacological approaches will be covered against the backdrop of relevant model sensory systems.

755. Research Design in Sensory and Systems Neurobiology (3). This course combines didactic material with hands-on approaches so that students learn to properly design experiments in neurobiology and are able to analyze quantitatively the resulting experimental data. The didactic component provides a brief survey of fundamental mathematical and statistical concepts (e.g., probability, Bayesian inference, curve fitting, hypothesis testing, nonparametric statistics), which serves as a foundation for more advanced techniques used to analyze neuronal data (e.g., signal detection theory, cross-correlograms, information theory). Through computer-lab sessions and homework assignments tailored to each topic, students translate the theoretical knowledge to practical application as they learn to use the Matlab programming environment. The specific quantitative methods covered, as well as the sample data used for the hands-on analysis assignments, are tailored according to the students' backgrounds, programming experience, and research interests.

See also:

BIO 664. Sensory Biology. (4) Lecture and lab course that examines a variety of sensory systems. The emphasis is on sensory physiology, although other aspects of sensory systems, e.g. molecular biology and anatomy, are also covered. In the laboratory, students learn several different procedures which they use to conduct assigned experiments. A final project is required in which students design and carry out their own experiments.

BIO 736. Bioacoustics. (4) Analysis of the mechanisms of sound production, transmission, and reception, and their relevance to animal orientation and communication.

Substance Abuse and Addiction

717. Current Topics in Drug Abuse. (2-3) Provides students with perspective in the problem of drug abuse. Defines the basic issues central to the field of drug abuse, including concepts of tolerance, physical dependence and reinforcement mechanisms, and relates these issues to the current problems of drug abuse in society. Describes how current research in drug abuse contributes to the design of rational treatment and prevention programs. Also listed as IPP 717.

724. Biology of Alcohol Abuse—Alcoholism. (3) Designed to instruct graduate and postdoctoral students on the pharmacological, physiological, and behavioral effects of alcohol. Lectures cover topics ranging from the epidemiology and etiology of alcohol abuse and alcoholism to the basic biochemistry, metabolism, and pharmacokinetics of alcohol in the mammalian system. Lectures concerning effects of alcohol on specific organ systems include the hepatic system, the endocrine system, reproductive systems, the cardiovascular system, the gastrointestinal system, and the renal and pancreatic systems. Lectures focusing on the effects of alcohol on the nervous system include neuroreceptor interactions, ethanol's effects on intracellular signaling processes, neuroanatomical substrates for the actions of alcohol, systems electrophysiology, and mechanism of the behavioral effects of alcohol such as the reinforcing effects, anxiolytic effects, amnesic effects, and motor impairing effects. The neuroscience lectures provide the basis for an exploration of the conditions leading to tolerance and dependence, and how the brain adapts to prolonged exposure to alcohol. Also listed as IPP 724

740. Neuropharmacology. (3) General survey of neuropharmacology, emphasizing neurotransmitters, receptors and their interactions. Discusses general principles of drug action, including receptor binding, second messengers, and neurotransmitter metabolism. Surveys neurotransmitter function, including acetylcholine, biogenic amines, excitatory and other amino acids, and neuropeptides. Also listed as IPP 740.

Translational Neuroscience

771. Clinical Neuroscience (3). Lectures and class discussions dealing with topics in neurobiology, pathophysiology, and treatment of patients with neurological and behavioral/psychiatric problems. Includes a brief introduction to major concepts of patient treatment and care with utilization of up-to-date methodology in clinical neuroscience. Students have the opportunity to observe and participate in patient evaluation and diagnostic testing in the clinical setting and to visit many of the neuroscience-related clinical research and treatment centers. Taught by both clinicians and basic science researchers.

See also:

BMES 631. Introduction to Regenerative Medicine. (3) The course explores the current state of the field of regenerative medicine with specific emphasis on the technological challenges that limit the efficacy and clinical translation of engineered tissues and therapies. Course content will be presented from both the life science (e.g., cell biology, organ physiology, biochemical methods) and engineering perspective (e.g., transport phenomena, materials engineering) to compare and evaluate alternative approaches and strategies that are being developed and tested. Emphasis is placed on the promising roles of stem cells, biologically-inspired materials, and gene therapies. P—Graduate standing or consent of instructor. Undergraduate biology and calculus are suggested.

BICM 740. Drug Discovery, Design and Development – Molecules to Medicine. (3) Conducted as a combination of lectures, reading assignments, and student-led discussions. Examines drug discovery and development pathways from target and lead compound identification through metabolic and toxicology studies, clinical trials, FDA approval, and marketing. Regulatory processes, intellectual property, and ethical issues are also considered. Taught by WFU faculty from both the Reynolda and Bowman Gray campuses and colleagues in the pharmaceutical and biotechnology industries, students work in teams to present case studies on the discovery, development, and marketing of recently approved pharmaceuticals.

Neurosciences Journal Clubs

780, 781. Directed Journal Club in Sensory Neuroscience. (1) Correlates with the formal lecture courses in Sensory Neuroscience I-II. Students are required to read and critique papers chosen to complement the classroom lectures. Both seminal papers and current research are reviewed. The directed nature of the readings enhances the student's appreciation and understanding of the formal lectures. Students lead the presentation of the journal articles, thus providing opportunities for teaching in the area of sensory systems.

783, 784. Directed Journal Club in Developmental and Molecular Neurobiology. (1) Students are required to read and critique papers related to developmental, cell and molecular, or disease/pathological issues in the nervous system. Both seminal papers and current research are reviewed. The directed nature of the readings enhances the student's appreciation and understanding of the formal lectures. Students lead the presentation of the journal articles, thus providing opportunities for teaching in these areas.

785, 786. Directed Journal Club in Network Science in Neuroimaging. (1) This journal club covers articles related to network science and its application in biological systems, with a particular emphasis on the brain. Assigned reading will cover methodological foundation of network science, as well as the current literature on applications of network science in neuroimaging studies. Although the brain network will be of the main focus, readings may also include other types of networks such as biological, social and technological networks.

787, 788. Memory, Cognition and Aging Journal Club. (1) The topics in this journal club will cover all aspects of memory, cognition and cognitive aging from molecular and cellular/synaptic mechanisms to behavioral and imaging studies. Papers on basic research and translational science in any model system ranging from rodent, non-human primates to humans will be discussed. In the Journal Club course, each week a student will present a paper using a format indicated by the course director.

789, 790. Behavioral Pharmacology Journal Club. (1) In this course, students read and present journal articles of current or historical importance that involve drugs and have behavior as the primary dependent variable.

Neurosciences Special Topic Courses

713, 714. Advanced Readings. (2) Individualized instruction involving detailed review of literature pertaining to a specific area of interest in physiology and pharmacology.

782. Readings and Research in Neuropsychology. (1-3) Allows the graduate student, working under the supervision of a faculty member, to pursue and receive credit for a special project in an area not covered by regular courses or a special research project not related to the master's thesis. Supervising faculty member and credit hours for the course are determined by graduate committee prior to registration. Also listed as PSY 782

791, 792. Readings and Directed Study in Neurobiology. (1-2) Designed to provide an opportunity for graduate students to learn specific topics in the field that may not be covered by regular courses. Materials from the primary literature are presented to other participants, including at least one faculty member. The format is intended to generate in-depth discussion in a setting where each student acts as the lecturer. The supervising faculty member and the student will determine together the schedule and credit hours (either 1 or 2) for the course.

793, 794. Special Topics in Developmental Neurobiology. (2) Designed to focus on a specific theme each semester, including such topics as cell death and regressive events, synaptogenesis, determination and differentiation, axonal guidance and pathway formation, neuroglia interactions, and neurotrophic agents.

795. The Development and Anatomy of Sensory Systems. (2) Designed as an introduction to the structure and ontogeny of the sensory pathways. Provides a foundation for the subsequent advanced coursework in sensory systems, which provides one of the most fertile experimental areas in developmental biology. Topics include basic genetic control of developmental processes; embryonic development of the sensory nervous system; development and organization of subcortical sensory pathways; development of sensory cortices; role of the environment in neural development; and the genetics of neuronal ontogeny.

796, 797. Special Topics in Sensory Neuroscience: Hearing and Multi-Sensory Integration. (2) Emphasizes current topics in neuroscience pertaining to sensory systems. Topics cover neurobiology of individual sensory systems such as visual, auditory, somatosensory, olfactory, and gustatory systems.

The importance of multi-sensory integration, i.e. how different sensory systems function together to generate perception, is highlighted. Includes lectures, seminars, discussions, and reading assignments in the area of interest. P—POI

798. Manuscripts, Seminars, and Posters. (2) A highly interactive course with enrolled students receiving detailed feedback on all written assignments. Covers areas such as writing style, composing abstracts, constructing figures and legends, as well as simulating the e-submission process (text, figures, cover letter, etc.). In addition, previously published work is dissected for style, structure, and presentation. Didactic lectures cover a wide range of subjects, including but not limited to, EndNote (for Web); basics of Adobe Illustrator; authorship issues, and responses to reviewer's comments. Background in neuroscience not required. Open to graduate students from all programs.

Joint International Cognitive Neuroscience (ICN) PhD Program

University of Bologna and Wake Forest

This is an innovative PhD program that upon successful completion will result in a Ph.D. conferred jointly by the University of Bologna and Wake Forest University. The program has been crafted by the Department of Psychology of Bologna, which will also serve as the sponsoring establishment, but involves a number of prestigious foreign institutions: University College of London, UK, University of Bangor, Wales, UK, INSERM U534 Espace et Action, Bron, France and Wake Forest University.

The ICN program emphasizes the neural bases of cognitive disorders and the mechanisms of functional recovery. Cognitive neuroscience is concerned with how cognitive and emotional functions are implemented via the architecture of the human brain. A key factor in the development of this discipline has been the integration of several academic disciplines that have historically been quite separate. These include: cognitive psychology; neuropsychology; neuroimaging; neurophysiology and neuroanatomy. Technological advances in methods for non-invasive brain imaging/recording now allow scientists to study the relationship between brain activity and cognitive mechanisms in awake, behaving, human subjects.

The goal of the program is to expose students to the highest standards of research and critical thinking from leaders in the field regardless of their location. In this way students will not only develop a profound understanding of their chosen field, and a familiarity with the most advanced techniques that are currently in use in this field, but will also be given access to experts.

Structure of the ICN PhD Program

Graduate students training and research activity will take place both in Bologna and in one of the partner Institutions (i.e., WFU), which will be chosen according to the student interests, competences and research field of the thesis work. Students interested in ICN must apply through the University of Bologna. (<http://neuroscience.psice.unibo.it>) Students will discuss potential thesis projects and select an advisor

and lab at the University of Bologna or partner institution upon entering the program. Students will begin their training at the University of Bologna by completing the required courses and passing the qualifying exam for admittance to candidacy for the Ph.D. After this, the student will then enter a selected laboratory at one of the participating Universities.

Required Courses

Research Methods in Cognitive Neuroscience. This course surveys major approaches and methods for cognitive brain research, both in normal individuals and in people afflicted by neurological or psychiatric disorders. Topics include functional neuroimaging (fMRI, PET), electrophysiological recordings (EEG, ERP), stimulation and inactivation methods (TMS), and also cognitive and behavioral approaches.*

Research Training for the Cognitive Neuroscience. Research training is the primary emphasis of the program. Training in research-related skills is acquired through interaction with the faculty and formal coursework, including project design, formulation of testable hypotheses, design of group and case studies in neuropsychology, statistical and data management techniques, and reporting of scientific findings.*

Neural Basis of Cognitive Processing. Course topics explore the relations between neural systems and cognition, emphasizing perception, attention, space representation, motor control and memory. Furthermore, the course surveys the phenomenon of plasticity and recovery of function following damage to the nervous system.*

Seminars on Social and Cognitive Neuroscience. This course surveys the neural basis of social behavior, drawing on both theoretical and empirical approaches. Topics include perception of social cues, motivation, emotion, imitation and empathy, and brain processes in economic decisions.*

Journal Club. A central didactic feature of the program is a weekly journal club for the trainees and faculty. This meeting gives trainees a forum for discussion, assistance and task-relevant learning. At the core of this seminar are regular presentations by the trainees as they develop their research ideas, formalize their research projects and progress with data collection.

Ethics Requirement. Students in the ICN will be required to complete the requirements in scientific ethics and professional development required of all graduate students at Wake Forest University.

**These courses are available only to students accepted into the ICN Program. These courses are taken at the University of Bologna upon matriculation into the program.*

Physics (PHY)

Reynolda Campus

Chair Keith Bonin

Reynolds Professors Jacquelyn Fetrow, Richard T. Williams

Harbert Family Distinguished Chair Professor Daniel B. Kim-Shapiro

Professors Paul R. Anderson, Keith D. Bonin, David Carroll, Natalie A. W. Holzwarth, George Eric Matthews

Professors Emeritus Robert Brehme, George M. Holzwarth, William C. Kerr, Howard Shields, George P. Williams Jr.

Associate Professors Eric D. Carlson, Gregory B. Cook, Martin Guthold, Jed Macosko, Fred Salsbury

Assistant Professors Samuel Cho, Oana Jurchescu, Timo Thonhauser

Research Professors George M. Holzwarth (professor), William C. Kerr (professor), K. Burak Ucer (associate professor), Swati Basu (assistant professor)

Lecturer Jack Dostal

Adjunct Associate Professor Peter Santago

Adjunct Assistant Professors John D. Bourland, Timothy E. Miller

The Department of Physics offers programs of study leading to the MS and PhD degrees. Opportunities for study are those usually associated with large research universities, while the atmosphere of a small liberal arts university with an ideal faculty/student ratio is maintained.

For admission to graduate work, the entering student should have knowledge of undergraduate mechanics, electricity and magnetism, thermodynamics, and quantum physics. The course of study for each student is planned in conference with the graduate adviser after an evaluation of academic background and experience. Deficiencies may be removed during the first year of study.

For the MS degree, the student's course of study must include PHY 711, 712, and 741, as well as participation in departmental seminars. These seminars, in fields of special interest, are regularly scheduled and usually feature outside speakers. In addition to satisfying the residency and course requirements, the student must be admitted to candidacy, complete an acceptable thesis under faculty supervision, and pass an oral examination in its defense.

For the PhD degree, the student's course of study must include PHY 711, 712, 741, 742, and 770 unless satisfactorily completed elsewhere. Students must also take three elective courses at the graduate level (600 or 700 level), one of which must be in physics. Students must also take GRAD 707 and 708 during their first year—see Courses in General Studies. To graduate, students must achieve a 3.0 grade point average in graduate courses within the physics department. The University's preliminary examination requirement is satisfied by passing a written preliminary examination usually taken at the end of the first year of graduate study. The examination may be retaken once. Students must have at least a 3.0 grade point average to take the preliminary examination. A research advisory committee, appointed after completion of the preliminary examination, determines the additional courses needed for the PhD, such as Advanced Quantum Mechanics, Biophysics, Solid State Physics, General Relativity, Nonlinear Optics, Math or Computer Science, Medical Engineering, etc. Within twelve months of completing the preliminary examination, the student submits to his or her individual advisory committee, and defends orally a dissertation research plan. The research advisory committee meets annually with the student to ensure timely progress toward the degree. Upon completion of the research in the approved plan, the student writes his or her dissertation, presents it to the department, and defends it orally as prescribed by the Graduate School.

The research interests of the graduate faculty are in experimental and computational biophysics, nanotechnology, optics, experimental and theoretical solid state physics, particle physics, and relativity. All research laboratories are well-equipped with state-of the instrumentation, such as subpicosecond pulsed lasers; EPR; time-resolved, UV-vis spectrophotometers; optical tweezers; atomic force microscope; single molecule manipulators; high-sensitivity optical and confocal microscopes; numerous, standard biochemical research apparatuses; and others. The Center of Nanotechnology and Molecular Materials (www.wfu.edu/nanotech), which houses state of the art electronmicroscopies, and sample analysis and preparation instruments and a clean room, is part of the physics department. Theoretical research is supported by the DEAC Linux Cluster (153 computational nodes).

For more details on the PhD program, visit www.wfu.edu/physics or write to the chair of the graduate committee. Departmental graduate committee: Guthold (chair), Anderson, Bonin, N. Holzwarth, Macosko, Thonhauser.

601, 602. Physics Seminar. (0.5, 0.5) Discussion of contemporary research, usually with visiting scientists.

607. Biophysics. (3) Introduction to the structure, dynamic behavior, and function of DNA and proteins, and a survey of membrane biophysics. The physical principles of structure determination by X-ray, NMR, and optical methods are emphasized.

610. Extragalactic Astronomy and Cosmology. (3) Topics covered include galactic structure, models for galaxies and galaxy formation, the large-scale structure of the universe, the Big Bang model of the universe, physical processes such as nucleosynthesis in the early universe, and observational cosmology.

620. Physics of Biological Macromolecules. (3) Physics of biologically important molecules, especially proteins and nucleic acids. Topics covered include the physical basis of biomolecular structure, the energetics and statistical mechanics of biomolecular dynamics, and the electrostatics and solvation of biomolecules. Course requirements may include a field trip to a relevant conference, such as the Carolina Biophysics Symposium, and a discussion section with an appropriate physics colloquium speaker. Designed to be accessible to students with biochemistry, chemistry, or physics backgrounds provided they have some exposure to thermodynamics and macromolecular structure. C—PHY 623.

623. Computational Molecular Biophysics Laboratory. (1) Application of techniques in molecular modeling, including energy minimization, molecular dynamics simulation, and conformational analysis, to biological macromolecules. C—PHY 620.

625. Biophysical Methods Laboratory. (1) Lab involves experiments using various biophysical techniques such as electron paramagnetic resonance, atomic force microscopy, stopped-flow absorption spectroscopy, X-ray diffraction, and gel electrophoresis. C—PHY 607.

637. Analytical Mechanics. (1.5) The Lagrangian and Hamiltonian formulations of mechanics with applications. Taught in the first half of the fall semester.

639, 640. Electricity and Magnetism. (1.5, 3) Electrostatics, magnetostatics, dielectric and magnetic materials, Maxwell's equations and applications to radiation, relativistic formulation. The first half course is taught in the second half of the fall semester, following PHY 637. The other course is taught in the spring semester. These should be taken in sequence. P—PHY 601.

641. Thermodynamics and Statistical Mechanics. (3) Introduction to classical and statistical thermodynamics and distribution functions.

- 643, 644. Quantum Physics.** (3,3) Application of the elementary principles of quantum mechanics to atomic, molecular, solid state, and nuclear physics.
- 645. Advanced Physics Laboratory.** (1) The lab associated with PHY 643, 644.
- 652. Physical Optics and Optical Design.** (4) Interaction of light with materials; diffraction and coherent optics; ray trace methods of optical design. Lab—three hours.
- 654. Introduction to Solid State Physics.** (3) Survey of the structure, composition, physical properties, and technological applications of condensed matter. P—PHY 643.
- 661. Biophysics Seminar.** (1) Seminal and current publications in biophysics are studied. Each week a member of the class makes an oral presentation on a chosen publication and leads the ensuing discussion. Students may also be required to prepare and present a second oral presentation relevant to their own research. Does not fulfill course requirements for Master's or PhD degrees.
- 663. Condensed Matter Seminar.** (1) Seminal and current publications in condensed matter physics are studied. Each week a member of the class makes an oral presentation on a chosen publication and leads the ensuing discussion. Does not fulfill course requirements for Master's or PhD degrees.
- 681, 682. Research.** (1-3, 1-3) Library, conference, and lab work performed on an individual basis.
- 685. Bioinformatics.** (3) Introduces bioinformatics and computing techniques essential to current biomedical research. Topics include genome and protein sequence and protein structure databases, algorithms for bioinformatics research, and computer architecture and environmental considerations. P—Introductory courses in biology, chemistry, and molecular biology or biochemistry or POI. Also listed as CSC 685.
- 691, 692. Special Topics in Physics.** (1-4) Courses in selected topics in physics. May be repeated if content differs.
- 711. Classical Mechanics and Mathematical Methods.** (3) A study of variational principles and Lagrange's equations, the rigid body equations of motion, the Hamilton equations of motion and canonical transformations, Hamilton-Jacobi theory, and applications to continuous systems and fields.
- 712. Electromagnetism.** (3) A study of Maxwell's equations, boundary value problems for the electromagnetic field, and radiation; the ponderomotive equation for the charged particle.
- 715. Nonlinear Optics and Quantum Electronics.** (4) Nonlinear phenomena in laser spectroscopy, the quantum nature of optical processes in matter, and topics in laser physics. Lab—three hours.
- 731. Elementary Particle Physics.** (3) Fundamentals of contemporary elementary particle physics.
- 741, 742. Quantum Mechanics.** (3, 3) Study of the foundations of modern quantum theory, with an emphasis on the meaning of the wave equation, operators, eigen-functions, eigenvalues, commutators, matrix mechanics, spin, and scattering.

743. Advanced Quantum Mechanics. (3) Advanced topics in quantum mechanics, including an introduction to relativistic quantum theory, quantum electrodynamics, and many particle treatments.

744. Introduction to Quantum Field Theory. (3) Introduction to relativistic quantum field theory, including canonical quantization, path integral techniques, perturbation theory, and renormalization.

745. Group Theory. (3) Group theory and its applications to the quantum mechanics of atoms, molecules, and solids.

752. Solid State Physics. (3) Introductory course including the structure of perfect crystalline solids, their thermal electronic properties, the free electron and band theory of metals, imperfect crystals, transport properties, and semiconductors.

754. Surface Science. (3) Experimental and theoretical methods for the study of surfaces and interfaces. Lab—1.5 hours.

756. Seminar on Defects in the Solid State. (2) The generation and interactions of point and line defects such as color centers, vacancies, and dislocations treated.

765. Gravitational and Particle Theory Seminar. (1) Topics in general relativity, particle physics, and astrophysics are studied. Each week a faculty member or member of the class makes an oral presentation on a chosen topic and leads the ensuing discussion. Does not fulfill course requirements for Master's or PhD degrees.

770. Statistical Mechanics. (3) Introduction to probability theory and to the physics of systems containing large numbers of particles from the classical as well as the quantum point of view.

780. Theory of General Relativity. (3) Study of the covariant formulation of physical laws in mechanics and electromagnetism.

785. Topics in Theoretical Physics. (1-3) Selected topics of current interest in theoretical physics not included in other courses.

787. Advanced Topics in Physics. (1-3) Lectures on advanced topics in physics that depend on the subspecialty of the instructor. Topics range from medical physics to special topics in biophysics, condensed matter physics, or quantum optics.

791, 792. Thesis Research. (1-9)

793. Summer Research. Summer research by continuing graduate students working with their adviser.

795. Physics for Education Research. (3) Fulfills the requirement for a graduate course in physics for students in the Masters in Education program seeking certification to teach physics.

891, 892. Dissertation Research. (Hours open)

Psychology (PSY)

Reynolda Campus

Chair Dale Dagenbach

William L. Poteat Professor of Psychology Deborah L. Best

Professors Terry D. Blumenthal, Christy M. Buchanan, Dale Dagenbach, William W. Fleeson, William C. Gordon, James A. Schirillo, Catherine E. Seta, Carol A. Shively

Associate Professors R. Michael Furr, Janine M. Jennings, Cecilia H. Solano, Eric R. Stone

Assistant Professors Lisa Kiang, John V. Petrocelli, Wayne E. Pratt, Dustin O. Wood

Adjunct Professors Jay R. Kaplan, W. Jack Rejeski Jr.

Adjunct Associate Professor C. Drew Edwards

The Department of Psychology offers graduate work leading to a research-oriented general master's degree. The general MA emphasizes the scientific, theoretical, and research bases common to all areas of psychology (e.g., social, cognition, personality, developmental, statistics).

The program is designed for capable students who expect to continue to the PhD degree but wish to begin graduate work in a department where they receive a high degree of individual attention from the faculty.

The applicant is expected to have an undergraduate major in psychology at an accredited institution, including a subset of basic foundational courses such as developmental, social, biopsychology, personality, cognition, learning, perception, etc., as well as statistics and/or research methods. The department does accept applications from students who were not psychology majors as undergraduates, but such applicants should have a background in coursework that prepares the student for graduate level work in psychology.

The department has unusually good research facilities. The areas in which research is currently being conducted include aging, cognitive processes, judgment and decision making, adolescent development, cultural identity, neuropsychology, perception, personality, physiology, and social psychology.

Most students take two academic years to complete the program. Students who hold assistantships are required to spend two years in residence. In addition to satisfying the University requirements for the degree, all graduate students must write a major research paper, and conduct and defend a thesis.

The MA degree has been offered since 1964. Departmental graduate committee: Seta (committee chair and program director), Furr, Kiang, Petrocelli, Stone, Schirillo, Dagenbach (ex officio).

613. History and Systems of Psychology. (3) The development of psychological thought and research from ancient Greece to present trends, with emphasis on intensive examination of original sources.

620. Physiological Psychology. (3) Neurophysiological and neuroanatomical explanations of behavior.

622. Psychopharmacology. (4) Survey of the influences of a wide range of psychoactive drugs, both legal and illegal, on human physiology, cognition, and behavior.

623. Animal Behavior. (3) Survey of lab and field research on animal behavior.

626. Learning Theory and Research. (3) Theory and current research in learning with emphasis on applications of learning principles for behavior modification and comparisons across species.

629. Perception. (3) Survey of theory and research findings on various sensory systems (vision, hearing, touch, taste).

631. Cognition. (3) Current theory and research in cognitive processes. Emphasis on memory, attention, visual and auditory information processing, concept identification/formation, and language.

- 633. Motivation of Behavior.** (3) Survey of basic motivational concepts and related evidence.
- 635. Fundamentals of Human Motivation.** (3) Description and analysis of some fundamental motivational phenomena, with special reference to human problems; includes reward and punishment, conflict anxiety, affection, needs for achievement and power, aggression, creativity, and curiosity.
- 638. Emotion.** (3) Survey of theory, methods, and research in the area of emotion. Developmental, cultural, social-psychological, physiological, personality, and clinical perspectives on emotions are given.
- 641. Research in Developmental Psychology.** (3) Methodological issues and selected research in child development. Research projects required.
- 642. Current Issues in Developmental Psychology.** (3) Intensive examination of selected theoretical or research issues in this area.
- 646. Psychological Disorders of Childhood.** (3) Survey of problems including conduct disorders, attention deficit disorders, depression, and autism. Emphasis on causes, prevention, treatment, and the relationships of disorders to normal child development and family life.
- 651. Personality Research.** (3) The application of a variety of research procedures to the study of human personality. Research projects required.
- 655. Research in Social Psychology.** (3) Methodological issues and selected research in the study of the human as a social animal. Field research projects required.
- 657. Cross-Cultural Psychology.** (3) Examination of differences in psychological processes (e.g., attitudes, perception, mental health, organizational behavior) associated with cultural variation.
- 659. Psychology of Gender.** (3) Exploration of the psychological similarities and differences between human males and females, including consideration of social, cognitive, motivational, biological, and developmental determinants of behavior.
- 661. Operant Conditioning and Behavior Modification.** (3) Principles, theory, and experimental research in operant learning, with applications to the modification of behavior in various populations and situations.
- 662. Psychological Testing.** (3) Theory and application of psychological assessment procedures in the areas of intelligence, aptitude, vocational interest, and personality.
- 663. Survey of Clinical Psychology.** (3) Overview of the field of clinical and other selected areas of applied psychology.
- 664. Stereotyping and Prejudice.** (3) Theoretical and empirical examination of the processes underlying prejudice, discrimination, and racism.
- 667. Parent-Child Relationships.** (3) Survey of popular approaches to child-rearing, with examination of the research literature on parent/child interaction and actual training in parental skills.
- 669. Contemporary Applications of Psychology.** (3) Supervised field experience in applied psychology.
- 674. Judgment and Decision Making.** (3) Theoretical and empirical examination of how people make decisions and judgments about their lives and the world, and how these processes can be improved.

678. Instrumentation for Psychological Research. (1) Lecture/demonstration presentation of electrical and mechanical equipment, followed by practical application in small group project work. Assumes no prior knowledge of electricity or construction.

692. Contemporary Problems in Psychology. (3) Seminar treatment of current theory and research in several frontier areas of psychology. Principally for senior majors planning to attend graduate school.

701, 702. Current Topics in Psychology. (1.5, 1.5) Seminar courses in selected topics in psychology. P—POI.

715, 716. Research Design and Analysis in Psychology. (3, 3) Intensive study of the design of experiments and the analysis of research data in psychology. Covers conventional methods, including univariate and multivariate analysis of variance, multiple regression, and factor analysis. Requires previous or concurrent coursework in basic statistics. Written permission of instructor required.

720. Biological Psychology. (3) Study of the biological basis of behavior and mental processes, with emphasis on current developments in neuroscience, and human applications of this information. Laboratory work in neuroanatomy and psychophysiology.

728. Human Cognition. (3) Current theory and research on functional characteristics and neural correlates of cognitive processes in such areas as memory, attention, and language.

738. Learning and Motivation. (3) Basic learning principles and concepts and related motivational concepts.

742. Seminar in Developmental Psychology. (3) Critical examination of the major findings, principles, and theories of development, with attention to both human and lower-animal research.

752. Seminar in Social Psychology. (3) Content and methodology of social psychology examined through a critical and comparative analysis of contemporary theory and literature.

757. Seminar in Personality Psychology. (3) Evaluation of contemporary solutions to important problems in personality psychology, with special attention to historical context and anticipated future directions.

761. Theory and Practice of Psychological Testing. (3) In-depth study of intelligence and ability testing as carried out by psychologists. Comparative analysis and examination of standard tests in these areas, with special focus on techniques of administration and interpretation.

767. Neuropsychology and Learning Disabilities. (3) Language, perceptual/motor, memory, attentional, and emotional deficits arising from neurological factors are studied in the context of brain functioning and information processing and applied to learning disabilities in children, in both theoretical and practical terms. P—POI. *Summer only.*

770, 771, 772, 773. Psychology Practicum. (1-3) Work experience in an applied psychology setting (such as clinical or industrial) under a qualified supervisor.

782. Readings and Research in Psychology. (1, 2, or 3) This listing allows the graduate student, working under the supervision of a faculty member, to pursue and receive credit for 1) a special reading project in an area not covered by regular courses or 2) a special research project not related to the master's thesis. Supervising faculty member and hours credit for which enrolled determined by graduate committee prior to registration. Also listed as NUSC 782. *Fall and spring.*

785, 786. Directed Thesis Research. (3, 3) First-year students undertake a substantial research project under the direction of their adviser.

791, 792. Thesis Research. (1-9, 1-9)

Religion (REL)

Reynolda Campus

Chair Jay Ford

Associate Chair Lynn Neal

Easley Professor of Religion Stephen Boyd

Albritton Professor of Religion Kenneth Hoglund

Washington M. Wingate Professor Simeon Ilesanmi

Professors Nelly van Doorn-Harder, Bill Leonard (School of Divinity), Ulrike Wiethaus

Associate Professors Jay Ford, Mary Foscett, Lynn Neal, Jarrod Whitaker

Assistant Professors Lucas Johnston, Tanisha Ramachandran

Emeritus Professor Fred Horton

Associated Faculty Michaelle Browers (politics), Stewart Carter (music), Andrew Ettin (English), Steve Folmar (anthropology), Robert Hellyer (history), Kevin Jung (School of Divinity), Christian Miller (philosophy), Jeanne Simonelli (anthropology), Patrick Toner (philosophy), Neal Walls (School of Divinity), David Yamane (sociology)

The Department of Religion offers the MA and a dual JD/MA in religion in a rigorous learning environment enriched by extended personal interaction with departmental faculty. The MA degree serves as either terminal degree or as preparation for further graduate study.

Ordinarily, applicants for admission into the MA in religion program have majored in religion or religious studies during their undergraduate coursework. Admission is based on the degree of success in previous courses in religion, the clarity of the applicant's educational goals, and the general potential for successfully engaging in graduate level work within the program. Applicants will not be admitted if it is likely that they cannot fulfill any of the program requirements, including the foreign language requirement. Any student admitted into the program without what the Graduate committee considers to be a well-rounded undergraduate course of study in religion will be required to take remedial coursework without graduate credit.

In addition to the University's requirements for the MA, the Department of Religion requires proficiency in a modern foreign language, normally German. Another modern foreign language may be substituted only if the student, with the consent of his or her adviser, can show that it is more relevant to his or her thesis research. For research in textual and/or historical studies, the primary ancient languages are required in addition to the modern foreign language requirement. Among the 24 required credit hours for the degree, a student must successfully complete REL 700 for admission to candidacy.

JD/MA in Religion Program

The JD/MA in Religion program facilitates an interdisciplinary and comparative study of law and religion and encourages students whose academic or career interests require gaining competence in both disciplines.

Interested students can combine the three-year law curriculum and the two-year MA curriculum into a four-year program. Students will first complete a year of work in the Department of Religion. Years two and three will be completed in the School of Law. For the fourth year, students will enroll in each school for one semester, completing any remaining degree requirements and elective courses that are joint-degree appropriate.

Law School Requirements

When undertaken as part of the joint JD/MA in Religion program, the JD degree requires completion of 75 hours of law coursework including the degree requirements prescribed by the law school for graduation.

Department of Religion Requirements

When undertaken as part of the JD/MA in Religion Program, the MA degree requires completion of 24 hours of graduate courses in religion which must include REL 700.

Academic Advising

Students will be provided a faculty advisor from each school to help guide them through the program and its curriculum. To make the most of the degree program, students will meet with both advisors at least once during each semester.

In the list of courses offered with graduate credit, not every course is scheduled every year, but usually 1-2 courses at the 700-level are offered each year, including REL 700: Theory and Method in the Study of Religion. In addition, we encourage students to approach individual professors to teach 700-level directed reading courses on specific topics. Substantive efforts are made to offer courses that are needed by students in either graduate course of study, and student input is welcome in determining the course schedule from semester to semester.

The general MA in religion program began in 1967. Departmental graduate committee: Whitaker (chair), Hoglund, Ilesanmi.

600. Approaches to the Study of Religion. (3) A phenomenological study of different ways of defining religion, including views of representative philosophers, psychologists, sociologists, anthropologists, theologians, and historians of religion.

601. Myth. (3) Study of the interpretation of myth, with a focus on the meaning and values implicit in the myths of contemporary culture.

602. Mysticism. (3) Study of mysticism from a multi-religious perspective with emphasis on the psychological and sociological aspects of this phenomenon.

603. Religion and Science. (3) Examination of the ways in which religion and science have conflicted with, criticized, and complemented one another in the history of Western thought from Galileo to the present.

605. Ethnography of Religion. (3) Study of theory and method in ethnography of religion where students closely read ethnographies from a variety of cultures and discuss the practical, methodological, and ethical issues related to ethnography. Culminates with students researching and writing their own ethnographies.

606. Ritual Studies. (3) An introduction to the various methods and theories employed in the field of ritual studies, while examining comparative rituals and ritualized practices from around the world.

- 608. Sacred Scripture in the Traditions of Abraham.** Comparative study of sacred texts in Judaism, Christianity, and Islam with particular attention to the issues authority, function, and interpretation.
- 610. The Prophetic Literature.** (3) Examination of the development and theological contents of the literary products of Israel's prophetic movement.
- 611. The Psalms.** (3) Study of the Psalter with particular emphasis on the setting of the Psalms in Israel's worship.
- 612. The Critical Study of the Pentateuch.** (3) Study of the five traditional books of Moses (the Torah) and various lines of analysis that modern Biblical critics have used to interpret their composition and role in the development of Israelite theological thought.
- 613. Near Eastern Archeology.** (3) Survey of 20th-century archeology in the Near East with attention to its importance for Biblical studies.
- 614. Ancient Israel and Her Neighbors.** (1.5) Study of ancient Near Eastern archeology with emphasis on Israel's relationships with surrounding peoples.
- 615, 616. Field Research in Biblical Archeology.** (3, 3) Study of the religion and culture of the ancient Near East through the excavation and interpretation of an ancient site.
- 617. Wisdom Literature.** (3) Examination of the development, literary characteristics, and theological contents of the works of ancient Israel's sages.
- 618. Feminist and Contemporary Interpretations of the Bible.** (3) Study of feminist and contemporary approaches to the Bible in light of the history of interpretation and a range of contemporary concerns and interpretive contexts.
- 619. Visions of the End: Jewish and Christian Apocalyptic.** (3) Reading and study of Daniel, Revelation, and certain non-Biblical apocalyptic texts.
- 620. The Search For Jesus.** (3) Introduction to the issues, assumptions, evidence, and debate that shapes the continuing quest for the historical Jesus.
- 621. Introduction to the New Testament.** (3) Intensive introduction to the literature of the canonical New Testament along with methodologies for its study.
- 622. The General Epistles.** (3) Exegetical study of two or more of the General Epistles with emphasis on the setting of the epistles in the life of the early church.
- 623. The Parables of Jesus.** (3) Examination of the historical, social, cultural, and theological significance of the parables of Jesus as recorded in the synoptic gospels.
- 624. Early Christian Literature.** (3) Examination of various literature and perspectives of the first three centuries of the Christian movement.
- 626. Early Christian Theologians: Paul.** (3) Introduction to the Pauline interpretation of Christianity and its place in the life of the early church.
- 630. Comparative Religious Ethics.** (3) Comparative study of the moral values and socio-ethical positions in the major religious traditions of the world, with focus on their various methods of reasoning and sources of authority.

- 631. Religion and Law.** (3) A study of religion and law as distinct yet interdependent spheres that influence cultural negotiations about authority, power, identity, and the regulation of society. Geographic and tradition-specific focus may vary with instructor.
- 632. Religion and Public Life.** (3) Examination of alternative historical paradigms within specific religious traditions and the implications of those paradigms for the public activity of their adherents. Traditions and topics, including religious leadership, social entrepreneurship and the separation of church and state, may vary with instructor.
- 635. Religious Ethics and the Problem of War.** (3) Examination of the causes and characteristics of war, various Christian response to it, and approaches to peacemaking, with attention to selected contemporary issues.
- 636. Religious Traditions and Human Rights.** (3) Study of the relationships and tensions between religious traditions and human rights, with illustrations from historical and contemporary issues and movements.
- 638. Religion, Ethics, and Politics.** (3) Examination of ethical issues in religion and politics using materials from a variety of sources and historical periods.
- 639. Religions of Africa.** (3) Interdisciplinary study of the growth and transformations of Africa's major religious traditions (Christianity, Islam, and the indigenous religions), and of their relations with secular social changes.
- 640. Men's Studies and Religion.** (3) Examination of the ways in which masculine sex-role expectations and male experiences have both shaped religious ideas, symbols, rituals, institutions, and forms of spirituality and been shaped by them. Attention is given to the ways in which race, class, and sexual orientation affect those dynamics.
- 641. Civil Rights and Black Consciousness Movements.** (3) A social and religious history of the African-American struggle for citizenship rights and freedom from World War II to the present.
- 642. Religion, Culture, and Modernity.** (3) Inquiry into the origins and development of modernity as idea and ideology, with emphasis on its significance for non-Western social and religious movements.
- 643. The City as Symbol.** (3) Study of the city, past and present, as a unique repository and symbol of religious values and human aspirations.
- 645. The African-American Religious Experience.** (3) Exploration of the religious dimensions of African-American life from its African antecedents to contemporary figures and movements.
- 647. The Emerging Church in the Two-Thirds World.** (3) Investigation of contemporary Christian communities in Africa, Asia, the Caribbean, and Latin America with special attention to theological, political, and economic activities.
- 648. Race, Memory and Reconciliation.** (3) Explores the collective memory and identity of American-Indian and African-American communities and the response to historical trauma in their cultural imagination, spirituality, and their political and social activism. Also listed as HST 648.
- 650. Psychology of Religion.** (3) Examination of the psychological elements in the origin, development, and expression of religious experience.
- 651. Religion and Society.** (3) Study of religion as a social phenomenon and its relationship to the structure of society—political, economic, and others, with special focus on the contemporary U.S.

- 654. Religious Development of the Individual.** (3) Study of growth and development from infancy through adulthood, with emphasis on the influences of spirituality and mature religion.
- 660. World Religions.** (3) Examination of the ideas and practices of major religious traditions in their historical and cultural context. Focus varies with instructor.
- 661. The Buddhist World of Thought and Practice.** (3) Survey of the development of Buddhism from India to Southeast Asia, China, Tibet, Japan, and the West, focusing on the transformation of Buddhist teachings and practices in these different social and cultural contexts.
- 662. Topics in Islam.** (3) Examination of the origins and development of Islam, the world's second largest religious tradition. Attention is given to the formation of Islamic faith and practice as well as contemporary manifestations of Islam in Asia, Africa, and North America.
- 663. The Religions of Japan.** (3) Study of the central religious traditions of Japan from pre-history to the present, including Shinto, Buddhism, Zen Buddhism, Christianity, and Confucianism.
- 664. Conceptions of the Afterlife.** (3) Examination of the variety of answers given to the question, "What happens in death?" Attention is given to the views of Jews, Christians, Muslims, Hindus, and Buddhists and the ways their views relate to life in this world.
- 665. History of Religions in America.** (3) Study of American religions from Colonial times until the present.
- 666. Gender and Religion.** (3) Examination of the historical and contemporary interaction between religion and sex roles, sexism, and sexuality.
- 667. The Mystics of the Church.** (3) Historical study of the lives and thought of selected Christian mystics with special attention to their religious experience.
- 668. Protestant and Catholic Reformations.** (3) Study of the origin and development of Reformation theology and ecclesiology.
- 669. Radical Christian Movements.** (3) Study of selected radical movements in the Christian tradition and their relation to contemporary issues.
- 670. Women and Christianity.** (3) Study of the roles and contributions of women within the Christian tradition throughout history, and an analysis of the mechanisms of their oppression.
- 671. Theology and Sexual Embodiment.** (3) Survey of theological responses to human sexuality, with special emphasis on contemporary issues.
- 672. History of Christian Thought.** (1.5, 3) Study of the history of Christian thought, beginning with its Hebraic and Greek backgrounds and tracing its rise and development to modern times. The course may be divided into halves for 1.5 credits each:
- (a) *Patristic Thought* (b) *Medieval and Reformation Thought*
- 674. Contemporary Christian Thought.** (3) Examination of the major issues and personalities in 20th-century theology, both Western and non-Western.
- 676. Christian Literary Classics.** (3) Study of the major exponents of the Catholic, Protestant, and Orthodox traditions.

- 677. The Problem of Evil from Job to Shakespeare.** (3) Comparative analysis of the source and remedy of evil in Job, Aeschylus, Sophocles, Plato, Dante, and Shakespeare.
- 679. Feminist and Liberation Theologies.** (3) Exploration of social, political, and religious contexts that have given rise to contemporary theological understandings of salvation as freedom from conditions of oppression, poverty and exploitation.
- 680. The Main Streams of Chinese Philosophy and Religion.** (3) Introduction to the most important traditions in Chinese philosophy and religion: Confucianism, Daoism (Taoism), and Chinese Buddhism or Chinese Chan (Zen) Buddhism.
- 681. Zen Buddhism.** (3) An examination of the origins and development of Zen Buddhism from China (Ch'an) to Japan and contemporary America. Particular attention is given to Zen doctrine and practice in the context of the broader Buddhist tradition.
- 682. Religion and Culture in China.** (3) A thematic study of Chinese religious traditions and culture focusing on history, ritual, scripture, and popular practice. Topics include cosmology, ancestor veneration, shamanism, divination, and the role of women.
- 683. The Qur'an.** (3) Introduction to the history, content, and main approaches to the sacred book of Islam. Focus is on the early centuries of Islam and major developments in the twentieth and twenty-first centuries.
- 684. Muhammad: Prophet and Paradigm.** (3) Exploration of the issues, assumptions, evidence, and debates that frame the various ways Muslims and non-Muslims understand the prophet of Islam. *Kimball*
- 685. Topics in South Asian Religions.** (3) Variable topics in the religions of South Asia. May be repeated for credit if topic varies.
- 686. The Indian Epics in Performance.** (3) Examines the two Indian epics, the *Mahabharata* and *Ramayana*, while considering issues of oral transmission, aesthetic theory, and epic performance.
- 687. Priests, Warriors, and Ascetics in Ancient India.** (3) Introduces students to the history, culture and religious traditions of ancient India by examining the overlapping practices, beliefs, ideologies, and gender representations of priests, warriors, kings, and ascetics.
- 688. (3) South Asian Women: Religion Culture & Politics.** This course examines the intersection of religion, race, and gender of South Asian women from a feminist and postcolonial perspective.
- 690. Special Topics in Religion.** (3) Religion topics of special interest. May be repeated for credit.

Seminars

- 700. Theory and Method in the Study of Religion.** (3) Explores the history of and methodological resources for the study of religion. Focus may vary according to the instructor, but the emphasis is on the ways religion has been defined, studied, and interpreted over the last several centuries.
- 701, 702. Directed Reading.** (1-3, 1-3)
- 703. Postmodern Perspectives on Power, Symbolism, and Performance.** (3) A critical examination of postmodern theories on religion as a part of culture.

- 704. Conceptions of the Ultimate.** (3) A comparative study of religious conceptions of the ultimate (divine, sacred) within Eastern and Western traditions through a range of methodological lenses including phenomenological, philosophical, theological, and sociological.
- 705. Research in Religion.** (3) Tools and methodologies applicable to research in religion. Fulfills the three hours in research methods that the religion department requires of first-year MA students.
- 708. Religious Language and Symbol.** (3) Examination of the distinct use of language in religious discourse, with attention to theoretical understandings of human language, the variety of philosophical efforts to define the validity of religious language, and the role of metaphor and analogy in religious communication.
- 716. Old Testament Theology.** (3) Major motifs of revelation in the Old Testament; analysis of recent attempts to write an Old Testament theology.
- 718, 719. Old Testament Exegesis.** (3, 3) Detailed analysis and exegesis of selected portions of the Hebrew Bible. P—Biblical Hebrew.
- 720. History of Biblical Interpretation.** (3) Detailed study of the history of biblical interpretation and hermeneutics.
- 721. New Testament Theology.** (3) Delineation of an approach to New Testament theology as a whole, a consideration of the hermeneutical problem, and an examination of two or three themes in New Testament theology.
- 723, 724. New Testament Exegesis.** (3, 3) Examination of selected portions of the Greek New Testament, with attention to the tools necessary for exegesis. P—Koine Greek.
- 726. Seminar in Early Christianity Studies.** (3) An intensive study of selected topics and texts in early Christianity studies.
- 737. Figures and Traditions in Religious Ethics.** (3) Seminar course that examines the basic ethical works and theories of central figures in Western and non-Western traditions. Students engage in close readings of important texts in religious thought and morality and produce essays reflecting on the themes addressed by the authors.
- 738. Seminar in Christian Social Ethics.** (3) Critical study of classic texts and figures in the history of Christian ethics and social thought.
- 740. Seminar in the Sociology of Religion.** (3) Examination of selected classical and contemporary texts illustrative of the theories, methods, and purposes of the sociological study of religion.
- 751. Theory and Practice of Pastoral Counseling.** (3) Study of counseling methodologies, psychotherapeutic techniques, personal development, and human behavior in terms of the implications for pastoral counseling.
- 755, 756. Clinical Pastoral Education.** (3, 3) Clinical experience in pastoral care, including work in crisis situations, seminars, interdisciplinary clinical group sessions, formal pastoral counseling, urban ministry assignments, and participation in group therapy. (Both semesters must be completed.)
- 761. Seminar in Eastern Religion.** (3) Directed study in selected areas of the religious traditions of the East.

762. The Literature of Ancient Judaism. (3) Examination of the rabbinic writings (Mishnah, Tosefta, Talmud, Midrashim, Targumim, and the Liturgy), the Dead Sea Scrolls, the Old Testament Apocrypha and Pseudepigrapha, and the literature of Hellenistic Judaism (e.g., Philo and Josephus).

763. Hellenistic Religions. (3) Consideration of available source materials, questions of method, and bibliography related to such Hellenistic religions as the Mysteries, Hellenistic Judaism, and Gnosticism.

766. Seminar in Christian History. (3) Directed study of selected areas in the history of Christianity, including Baptist history.

768. The Protestant and Catholic Reformations. (3) Study of the origin and development of Reformation theology and ecclesiology.

771. Religions in America. (3) A study of religious traditions, events, and individuals shaping religious life in America. Attention is given to native religious, colonization, denominations, awakenings, religious liberty, the western movement, and the rise of the "American Self." The development of pluralism and the impact of immigration, civil rights, and "new religions" are also studied.

775. Seminar in the History of Christian Thought. (3) Intensive study of a selected period or movement in Christian theological history, with special reference to seminal persons and writings.

780. Seminar in Theology and Literature. (3) Intensive study of a single theologian in relation to a literary figure with a similar religious outlook, the aim being to investigate how literature and theology mutually invigorate and call each other into question. Representative pairings: Niebuhr/Auden, Barth/O'Connor, Tillich/Updike, Newman/Eliot, Kierkegaard/Percy. May be repeated for credit if the writers studied are different.

781. Special Topics in Religion. (3) An intensive, in-depth study of a selected issue in the study of religion. Focus varies with instructor.

791, 792. Thesis Research. (1-9)

Near Eastern Languages and Literature (NLL)

111, 112. Elementary Hebrew. (3, 3) A course for beginners in the classical Hebrew of the Bible, with emphasis on the basic principles of Hebrew grammar and the reading of Biblical texts. (Both semesters must be completed.)

113. Standard Literary Arabic. (3) Introduction to the principles of Arabic grammar and a reading of selections from the Quran.

153. Intermediate Hebrew. (3) Intensive work in Hebrew grammar and syntax based upon the reading of selected texts. Readings emphasize post-Biblical Hebrew. P—NLL 111, 112, or equivalent.

211, 212. Hebrew Literature. (3, 3) The reading and discussion of significant Biblical texts. P—NLL 153.

601. Introduction to Semitic Linguistics. (3) Study of the history and structure of four languages from the Hamito-Semitic family of languages.

602. Akkadian I. (3) Analysis of the phonology, morphology, and syntax of the East Semitic languages of the ancient Near East as they relate to the larger family of Semitic languages.

603. Akkadian II. (3) A continuation of NLL 602 with further emphasis on building expertise in vocabulary and syntax through the reading of texts from the Middle Babylonian period.

610. Readings from the Rabbis. (1) Analysis of selected classical Hebrew texts designed to expand the student's facility with Hebrew. May be repeated for credit. P—NLL 153 or POI. On request. .

611. Aramaic. (3) The principles of Aramaic morphology, grammar and syntax based on readings from the Bible and other ancient Near Eastern texts. P—NLL 112 or POI. On request.

614. Readings from the Rabbis. (3) Texts in Hebrew and Aramaic from the Talmud and Midrash. P—NLL 611 or POI. On request. .

615. Syriac. (3) A study of the grammar, syntax, and scripts of Syriac based on the reading of selected texts. P—NLL 611 or POI. On Request.

621, 622. Introduction to Middle Egyptian I & II. (3, 3) The phonology, morphology, and grammar of Middle Egyptian. On request.

625. Coptic. (3) The phonology, morphology, and grammar of Sahidic Coptic with special emphasis on the texts from Nag Hammadi. Some knowledge of Greek is helpful. On request.

Interdisciplinary Graduate Track in Structural and Computational Biophysics (SCB)

Programs of Biology, Chemistry, Computer Science, Mathematics, Molecular and Cellular Biosciences and Physics

Director, Freddie R. Salsbury Jr

Professors Edward E. Allen, Keith D. Bonin, James F. Curran, Larry W. Daniel, Jacquelyn S. Fetrow, David J. John, Daniel B. Kim-Shapiro, S. Bruce King, Mark O. Lively, Douglas S. Lyles, Linda C. McPhail, Charles S. Morrow, Gloria K. Muday, James Norris, Fred W. Perrino, Leslie B. Poole, Lawrence L. Rudel, Peter Santago, Alan J. Townsend, Suzy V. Torti

Associate Professors Rebecca W. Alexander, Ulrich Bierbach, Martin Guthold, Roy R. Hantgan, Thomas J. Hollis, W. Todd Lowther, V. Paul Pauca, Freddie R. Salsbury Jr., Brian W. Tague, Stan J. Thomas

Assistant Professors David A. Horita, Jed C. Macosko, William H. Turkett Jr.

Research Professor George M. Holzwarth

Research Assistant Professor Derek Parsonage

The Interdisciplinary Graduate Track in Structural and Computational Biophysics (SCB) is designed to meet the need for scientists and educators with broad, interdisciplinary training in the quantitative biological, biochemical, and biomedical sciences. Students who successfully complete the SCB Track and degree requirements will receive a certificate in Structural and Computational Biophysics, as well as the degree in the program in which they matriculate. The Track is implemented by collaboration among the programs of Biology, Chemistry, Computer Science, Mathematics, Molecular and Cellular Biosciences and Physics at Wake Forest University.

Following matriculation and at least one semester of coursework in a participating department (currently Biochemistry, Biology, Chemistry, Computer Science, Mathematics and Physics), students can apply

for admission to the SCB Graduate Track. Admission to the Track is initiated by meeting with the SCB department representative. The student will then submit a letter of intent and a Wake Forest University graduate transcript to their department representative who will present it to the SCB advisory committee. The letter of intent should express the student's interest in the SCB program, a proposed plan of study, and how the SCB program meets the student's career and academic goals. Following favorable evaluation, applicants may be recommended for admission by the SCB advisory committee, with final approval determined by the Graduate School. Prior to admission, it is recommended that applicants complete coursework in introductory chemistry, introductory biology, introductory biochemistry, molecular biology, or cell biology, calculus-based physics, and programming in a high-level language; however, all applicants should meet the prerequisites for the individual graduate degree program to which they are applying (physics, chemistry, biology, mathematics, molecular and cellular biosciences or computer science).

Students in the Interdisciplinary Graduate SCB Track must complete all graduate degree requirements in the individual department to which they were admitted. (The official degree requirements for the PhD in Physics, Biology, Chemistry, or programs under the Molecular and Cellular Biosciences Track or the MS in Computer Science or Mathematics are described under the department listing.) In addition, at least 15 hours of the student's graduate coursework should consist of courses approved as part of the SCB Track (listed in this bulletin), including a general, introductory SCB course and two hours of journal club credit. At least one course must be at the 700 level. Students must take at least two graduate hours in each of the curriculum areas: chemistry/biochemistry, computer science/mathematics, and biophysics. All students in the SCB Track must complete and defend a PhD dissertation (or MS thesis for computer science or mathematics) that involves original, interdisciplinary research in the area of structural and computational biophysics or computational biology; broadly defined. The dissertation committee will consist of members from at least three participating SCB departments. All students must successfully complete a course in scientific ethics. Each semester, several seminars from the participating departments will be designated as SCB discussion group seminars. Students in the Track are required to attend these seminars.

Students in the SCB Track have access to state-of-the-art equipment and facilities in multiple departments, including the Wake Forest Structural Biology Facility (csb.wfu.edu), the DEAC Linux cluster (www.deac.wfu.edu), and well-equipped research laboratories in biophysics, biochemistry, and biomedical engineering.

The Interdisciplinary Graduate Track in Structural and Computational Biophysics began in 2005. Information on the program and links to faculty research interests can be accessed at scb.wfu.edu.

Courses listed in this bulletin are those currently approved for the Interdisciplinary Graduate Track in Structural and Computational Biophysics at Wake Forest University. (Other courses may be allowed with prior approval by the SCB Track advisory committee. Course descriptions can be found under the department which administers the course.)

SCB-specific courses.

SCB 701. Structural and Computational Biophysics Journal Club. (1) Seminal and current publications in structural and computational biophysics are read and discussed. P—Admission to the SCB graduate track or POI.

SCB 710. Research Topics in Structural and Computational Biophysics. (1) Lectures and discussions on research topics in the field of structural and computational biophysics and biochemistry. Topics depend on the specialty of the instructors in a given semester. P—Admission to the SCB graduate track or POI.

Curriculum Area 1. Chemistry/Biochemistry

General prerequisites: Two semesters of undergraduate chemistry and one semester of undergraduate biochemistry or molecular biology; one semester of organic chemistry is considered ideal, but is not required for most courses. (If additional prerequisites are required, they are listed individually by course.)

CHM 641. Fundamentals of Physical Chemistry. (3 or 4)

BICM 716. Special Topics in Biochemistry: Macromolecular X-ray Crystallography. (2)

P—one semester graduate level biochemistry.

BIO 672. Molecular Biology. (3 or 4)

BIO/CHM 670. Biochemistry: Macromolecules and Metabolism. (3)

BIO/CHM 670L. Biochemistry Laboratory: Macromolecules and Metabolism. (1)

CHM 672. Biochemistry: Protein and Nucleic Acid Structure and Function. (3)

CHM 751. Biochemistry of Nucleic Acids. (3)

CHM 752. Protein Chemistry: Structures, Methods and Molecular Mechanisms. (3)

CHM 756. Biomolecular NMR. (1.5) P—POI.

CHM 757. Macromolecular Crystallography. (1.5) P—CHM 356A/656 highly recommended.

MCB 700. Analytical Skills (1) Taught every August.

MCB 701. Molecular and Cellular Biosciences A. (1) Taught every fall.

Curriculum Area 2. Physics

General prerequisites: Two semesters of undergraduate physics. (If additional prerequisites are required, they are listed individually by course.)

PHY 607. Biophysics. (3)

PHY 625. Biophysical Methods Laboratory. (1) C—PHY 607.

PHY 685. Bioinformatics. (3) P—Introductory courses in biology, chemistry, and molecular biology or biochemistry or permission of instructor; also listed as CSC 685, though requirements and prerequisites are different.

PHY 620. Physics of Biological Macromolecules. (3) P—PHY 651 or CHM 641, or POI.

Curriculum Area 3. Computer Science/Mathematics

General computer science prerequisites: Programming in a high level language. (If additional prerequisites are required, they are listed individually by course.)

CSC 621. Database Management Systems. (3)

CSC 631. Object-oriented Software Engineering. (3)

CSC 646. Parallel Computation. (3)

CSC 652. Numerical Linear Algebra. (3)

CSC 655. Introduction to Numerical Methods. (3)

CSC 671. Artificial Intelligence. (3)

CSC 685. Bioinformatics. (3)

CSC 721. Theory of Algorithms. (3)

CSC 753. Nonlinear Optimization. (3) P—Computer Science 655.

CSC 754. Numerical Methods for Partial Differential Equations. (3) P—CSC 655 or MTH 655.

MTH 652. Partial Differential Equations. (3) P—MTH 251.

MTH 653. Mathematical Models. (3)

MTH 656. Statistical Methods. (3)

MTH 659. Multivariate Statistics. (3) P—MTH 656 and 602.

MTH 750. Dynamical Systems. (3) P—MTH 611.

MTH 761. Stochastic Processes. (3)

Courses in General Studies

701. Seminars in Professional and Career Development. A monthly seminar course, primarily for first-year graduate students, in which invited speakers give presentations on the training and career development that led them to their current professions. Typically, there are four speakers per semester from a variety of organizations, such as undergraduate colleges, research institutions, biotechnology and pharmaceutical companies, law firms, and scientific journal editorial offices. In addition to the formal presentations, students also have the opportunity to interact with speakers in smaller groups over lunch and in other informal settings. Each student is required to write a short paper at the end of the semester describing a career track, other than the one for which they are currently training, and their plan for becoming a competitive job applicant in that area.

702, 703. Internship. (1-9) Internships are available for a student who has completed one year of graduate study and desires experience working in the private sector or a nonprofit or government agency. Internships typically take place during the summer months and last for three months, although the timing and duration may be adjusted to satisfy each student's needs and the type of internship available. Credit hours are adjusted based on the length of the internship. The student receives a written evaluation from the host organization mentor and is required to submit a written report of his/her work. May be repeated.

704. Principles of Intellectual Property Development. (2) Designed for late-stage graduate students to supplement their scientific background with a greater understanding of intellectual property protection, commercialization, and start-up company formation. Numerous aspects of our knowledge-based economy will be covered including an overview of the diverse types of intellectual property protection available to protect inventions (with a focus on patents), the technology transfer process in an academic setting, a primer of company formation and organization, and an analysis of the different agreements (including confidential disclosure agreements, material transfer agreements, and license agreements) necessary to move a technology from the bench to the bedside. P—Scientific graduate students only.

705. Problem Based Learning (PBL). (1-3) Small group sessions with post-baccalaureate premedical program students to facilitate the development of clinical reasoning skills and basic and clinical science knowledge. Topics on ethics and professionalism and the doctor-patient relationship are discussed. A combination of case studies, reading assignments, course notes and group discussion will be used.

707. Professional Responsibilities and Conduct I. (1) Students learn to identify general and discipline-specific professional norms and obligations for the responsible practice of science. Emphasizes development of professional decision-making skills. This course or equivalent is required for Reynolda campus masters students who will be supported on federal grants. Pass/No credit.

708. Professional Responsibilities and Conduct II. (2) Students learn to identify general and discipline-specific professional norms and obligations for the responsible practice of science. Emphasizes development of professional decision-making skills. Required of all Reynolda campus doctoral students. Pass/No credit.

711. Introduction to College Teaching. (1) Prepares graduate teaching assistants for teaching roles. Coursework includes a 1-2 day orientation introducing students to the role and responsibility of being a teaching assistant, departmental orientation to teaching in the discipline, a series of educational workshops conducted by the Teaching and Learning Center, and classroom observation.

713, 714. Scientific Professionalism and Integrity. (1) The Problem-Based Learning Method (PBL) is used to teach students in small groups to identify discipline-specific and broad professional norms and obligations for the ethical practice of science. Content will include the norms and principles for the responsible conduct of scientific research such as data acquisition, management, sharing and ownership, publication practices, and responsible authorship. Emphasis will be placed on learning the tenets of responsible conduct of research, the current regulatory and legal climate, as well as the underlying norms and principles that shaped these concepts. Topics will include the student and advisor relationship, laboratory dynamics, collaborations in science, appropriate handling of data and appropriation of credit, plagiarism, conflicts of interest and financial responsibility. Students will acquire skills to recognize ethical issues in the practice of science, identify role obligations, and develop sound ethical reasoning to address these issues. The courses also include plenary session presentations by experts on topics of professional development, such as preparing manuscripts and grant applications and policies regarding conduct of animal and human subject research.

720. Topics in College-Level Teaching. (1-3) Students participate in the preparation and delivery of one or more lectures, homework assignments, and examinations, and facilitate small group learning sessions. Students attend at least two professional development workshops on a variety of aspects of the educational process. P—Successful completion of the first year of coursework in a biomedical graduate training program and POI.

722. Teaching Skills and Strategies Seminar. (2) Designed to provide students with formal training and development in teaching strategies and teaching scholarship. A variety of theories and pedagogies are reviewed and discussed. Students receive some practical experience in developing and delivering instructional materials and assessment tools. Meets weekly for two hours throughout the spring semester.

As a mechanism for enrichment of graduate studies at Wake Forest University, additional courses in liberal arts are offered for graduate credit. These courses are designed to provide special opportunities for students in the humanities and social sciences, but are open to students on either campus. The courses may be taken after consultation with the student's departmental advisory committee.

ANTHROPOLOGY

605. Museum Anthropology. (3) Examines, through hands-on use of the Museum's collections, the historical, social, and ideological forces shaping the development of museums, including the formation of anthropological collections and representation, and the intellectual and social challenges facing museums today.

607. Collections Management Practicum. (1.5) The principles of collections management including artifact registration, cataloging, storage, and handling; conservation issues and practices; disaster planning

and preparedness; and ethical issues are covered through lectures, readings, workshops, and hands-on use of the Museum's collections.

613. Tradition, Continuity, and Struggle: Mexico and Central America. (3) Acquaints students with the lives and struggles of indigenous and non-indigenous people of Mexico and neighboring countries, with special focus on the Maya. Includes study of contemporary and prehispanic traditions, including Mayan cosmology, language, art and architecture, issues of contact during Spanish colonization, and current political, economic, health, and social issues affecting these areas today.

615. Artifact Analysis and Laboratory Methods in Archeology. (3) Introduction to methods for determining the composition, age, manufacture, and use of different prehistoric and historic artifact types. Techniques for reconstruction of past natural environments from geological or ecofact samples. Exploration of data display tools including computer-based illustration, GIS, and archeological photography.

630. Seeing World Cultures. (3) Focuses on selected cultures throughout the world to better understand these societies through the use of ethnographic literature and assesses the effectiveness of visual communication in conveying ideas about these cultures through the use of ethnographic videos and films.

632. Anthropology of Gender. (3) Focuses on the difference between sex, a biological category, and gender, its cultural counterpart. An anthropological perspective is used to understand both the human life cycle and the status of contemporary women and men worldwide. In section one, topics covered include evolution and biological development, sexuality and reproduction, parenting and life cycle changes. The second section takes students to diverse locations, including Africa, South Dakota, China, India, and the Amazon for a cross-cultural comparison examining roles, responsibilities and expectations, and how these interact with related issues of class and race.

634. Peoples and Cultures of South Asia. (3) Survey of the peoples and cultures of the Indian subcontinent in the countries of Afghanistan, Bangladesh, Bhutan, India, Nepal, Pakistan and Sri Lanka. Reviews major topics of interest to anthropologists, including prehistory, history and politics, religion, social organization, caste, gender, development and population.

636. Myth, Ritual, and Symbolism. (3) Explores how people envision and manipulate the supernatural in cross-cultural perspective. Emphasizes functional aspects of religious beliefs and practices.

637. Economic Anthropology. (3) Examines the relationship between culture and the economy and its implications for applied anthropology. The variable nature and meaning of economic behavior will be examined in societies ranging from non-industrial to post-industrial. Discusses the impact of economic development programs, foreign aid and investment, technology transfer, and a variety of other economic aid programs.

639. Culture and Nature. (3) Exploration of humanity's "place" in the cosmos, focusing on different worldviews of nature and culture. Case studies from anthropology, archeology, and environmental science examine conceptions of technology, resources, environment, and ownership in the context of environmental change, "natural" disasters, and resource scarcity.

640. Anthropological Theory. (3) Study and evaluation of the major anthropological theories of humans and society. The relevance and significance of these theories to modern anthropology are discussed.

642. Development Wars: Applying Anthropology. (3) Explores the application of anthropological concepts and methods in the understanding of contemporary problems stemming from cultural diversity, including competing social and economic development models and ideologies of terror. Emphasizes conflict and change in developing areas but also considers the urban experience.

653/654. Field Research. (3, 3) Issues-based field program providing students with a critical understanding of the historical, social, political-economic and environmental conditions that have shaped the lives of the people of the Greater Southwest, with special attention to the Native American and Latino/a experience. The program moves from the Mexican border region through New Mexico and Arizona, focusing on border issues, archaeology and prehispanic history, and contemporary Native American culture. Students camp, hike, and learn to use digital technology in the field. Specific sites may vary from year to year.

655. Language and Culture. (3) Covers theoretical and methodological approaches to the study of language and culture, including: semiotics, structuralism, ethnoscience, the ethnography of communication, and sociolinguistics. Topics include: linguistic relativity; grammar and worldview; lexicon and thought; language use and social inequality; language and gender; and other areas.

658. Native Peoples of North America. (3) Ethnology and prehistory of the indigenous peoples and cultures of North America.

661. Evolution of Human Behavior. (3) The application of Darwinian principles to the study of human nature and culture. Considers the existence, origin, and manifestation of human behavioral universals and the theoretical and practical implications of individual variability.

662. Medical Anthropology. (3) The impact of Western medical practices and theory on Western and non-Western cultures and anthropological contributions to the solution of world health problems.

663. Primate Behavior and Biology. (3) Examines the evolution and adaptations of the order primates. Considers the different ways that ecology and evolution shape social behavior. A special emphasis on the lifeways of monkeys and apes.

664. Primate Evolutionary Biology. (3) Examines the anatomy, evolution, and paleobiology of members of the order Primates. Emphasis is on the fossil evidence for primate evolution. Topics covered include: primate origins, prosimian and anthropoid adaptations, patterns in primate evolution, and the place of humans within the order Primates.

665. Evolutionary Medicine. (3) Explicitly evolutionary approach to complex relationships between human evolutionary adaptations and health problems related to modern behavior and culture.

666. Human Evolution. (3) The paleontological evidence for early human evolution, with an emphasis on the first five million years of bio-cultural evolution.

668. Human Osteology. (3) Survey and analysis of human skeletal anatomy, emphasizing archeological, anthropological, and forensic applications and practice.

670. Old World Prehistory. (3) Survey of Old World prehistory, with particular attention to geological and climatological events affecting culture change.

674. Prehistory of North America. (3) The development of culture in North America as outlined by archeological research, with emphasis on paleoecology and sociocultural processes.

676. Archeology of the Southeastern United States. (1.5) Study of human adaptation in the Southeast from Pleistocene to the present, emphasizing the role of ecological factors in determining the formal aspects of culture.

677. Ancestors, Indians, Immigrants: A Southwest Cultural Tapestry. (3) Exploration of factors that shaped the lives of people in the Southwest, with attention to Native American and Hispanic experience. From kivas to casinos, coyotes to cartels, it links archeological and prehispanic history to contemporary lifeways in the canyons, deserts, and cities of the U.S./North Mexico.

678. Conservation Archeology. (1.5) Study of the laws, regulations, policies, programs, and political processes used to conserve prehistoric and historic cultural resources.

680. Anthropological Statistics. (3) Basic statistics, emphasizing application in anthropological research.

681, 682. Archeological Research. (3, 3) Integrated training in archaeological field methods and analytical techniques for researching human prehistory. Students learn archeological survey, mapping, excavation, recording techniques and artifact and ecofact recovery and analysis.

683, 684. Field Research in Cultural Anthropology. (3, 3) Comparative study of culture and training in ethnographic and cultural analysis carried out in the field.

685, 686. Special Problems Seminar. (3, 3) Intensive investigation of current scientific research within the discipline, concentrating on problems of contemporary interest.

687. Ethnographic Research Methods. (3) Designed to familiarize students with ethnographic research methods and their application. Considers the epistemological, ethical, political, and psychological aspects of research. Field experience and data analysis.

698. Individual Study. (3) Reading or research course designed to meet the needs and interests of selected students, to be carried out under the supervision of a departmental faculty member.

785. Directed Research and Reading. (3) Research and reading course, including field component, designed to meet the needs of individual students and resulting in a professional-quality paper and/or presentation. P—POI.

ART

696. Art History Seminar. (3) Offered by members of the faculty or visiting faculty on topics of their choice.

a. Ancient Art

b. Medieval Art

c. Renaissance Art

d. Baroque Art

e. Modern Art

f. Contemporary Art

g. American Art

h. Modern Architecture

i. American Architecture

j. Art and Popular Culture

k. Film

l. Architecture and Urbanism

m. Museums

n. Special Topics

CLASSICAL LANGUAGES

698, 699. The Teaching of Latin. (3, 3) A reading course and workshop in the problems of Latin pedagogy and the secondary Latin curriculum, designed to meet the needs and interest of selected students. P—POI.

HISTORY

605. Medieval and Early Modern Iberia. (3) The cultures that flourished on the Iberian peninsula between 700 and 1700 were diverse and contradictory. This course examines the formation of religious, cultural and political identities and the economics of empire in the medieval and early modern period.

607. Italian Renaissance. (3) Examination of the economic, political, intellectual, artistic, and social developments in the Italian world from 1350-1550.

- 608. The World of Alexander the Great.** (3) Examination of Alexander the Great's conquests and the fusion of Greek culture with those of the Near East, Central Asia, and India. Special emphasis on the creation of new political institutions and social customs, modes of addressing philosophical and religious issues, as well as the achievements and limitations of Hellenistic Civilization.
- 614. European Economic and Social History, 1700-1990.** (3) Changes in Europe's economic structures and how they affected Europeans' lives, emphasizing how economic forces interacted with social and institutional factors.
- 615. Greek History.** (3) The development of ancient Greek civilization from the Bronze Age to the end of the Classical Period stressing social institutions, individual character, and freedom of social choice within the framework of cultural, political, and intellectual history.
- 616. Rome: Republic and Empire.** (3) Survey of Roman history and civilization from its beginning to about 500 C.E., with emphasis on the conquest of the Mediterranean world, the evolution of the Republican state, the growth of autocracy, the administration of the empire, and the interaction between Romans and non-Romans.
- 617. The French Revolution and Napoleonic Empire.** (3) The revolution and wars that constitute one of the pivotal points in modern history.
- 618. Weimar Germany.** (3) Art, literature, music, and film of Weimar Germany, 1919-1933, in historical context. German or history credit determined at registration.
- 619. Poland and the Baltic Region.** (3) Introduction to the history of Poland and the eastern Baltic littoral since 1760, covering territory that later became Estonia, Latvia, Lithuania, and Poland; emergence of independence after World War I; the Soviet experience; and re-establishment of independence during the breakup of the Soviet Union.
- 628. History of the English Common Law.** (3) Study of the origins and development of the English common law and its legacy to modern legal processes and principles.
- 629. British Empire.** (3) A survey of Britain's global empire from the 17th century to its continuing influence on the Commonwealth, globalization, and violent conflict today.
- 630. Race, Religion, and Sex in Early Modern Europe.** (3) Explores issues of race, ethnicity, and gender in Europe between 1400 and 1800. Topics include contact and conflict among Jews, Muslims, and Christians; marriage, the family, and sexuality; migration and immigration; and slavery and conquest in early European colonies and empires.
- 633. European Diplomacy, 1848-1914.** (3) The diplomacy of the great powers, with some attention given to the role of publicity in international affairs. Topics include the unification of Italy and of Germany, the Bismarckian system, and the coming of World War I.
- 634. Mystics, Monarchs, and Masses in South Asian Islam.** (3) An introduction to Islam through South Asian social, political, cultural, and intellectual history.
- 635. Rebels, Reformers, and Nationalists in Modern South Asia.** (3) History of ideas and concepts such as nation, class, caste, and gender in colonial South Asia and an examination of socio-religious and intellectual movements within Hinduism and other Indic traditions.
- 636. Gender in African History.** (3) Examines the centrality of gender to the African past. Major topics include definitions of gender in African settings; the operation of gender in precolonial African

societies; gender and slavery; gendered transformations during colonial rule; gender, nationalism and independence; and the evolution of relationships between men and men, men and women, and women and women in various regions of the continent.

637. Gender in Early America. (3) The history of gender roles from the colonial period to the mid-19th century. Examines the social constructions of femininity and masculinity and their political and cultural significance.

638. Gender, Race and Class since 1800. (3) Analyzes how American political, economic, and cultural changes impact the definitions of femininity and masculinity, the changing notions of sexuality, and the continuity and diversity of gender roles, with special attention to race, class, and ethnicity.

639. Sickness and Health in American Society. (3) Analysis of major trends in health, sickness, and disease within the broad context of social, political, and economic developments. Examines indigenous healing; colonial medicine; emergence of hospitals and asylums; public health; race, class and gender issues; and natural versus high-tech approaches to health care in the 20th century.

640. Africa's Cities and Urban History. (3) Examines African cities in a historical perspective. Major topics include the structure of urban settlements in precolonial Africa, colonial and government efforts to regulate and reshape Africa's urban landscapes, cities as arenas of economic struggle, cultural transformations and political debates, urban gendered relations, and the contemporary conditions and challenges of African urban areas.

641. Africans in the Atlantic World, 1750-1815. (3) Explores Africans' experience in the Atlantic world (Africa, Europe, and the Americas) during the era of slave trade by examining their encounters with Indians and Europeans and their adjustment to slave traders in West Africa.

646. Japan before 1800. (3) A survey of Japan from the earliest times to the coming of Western imperialism with emphasis on regional ecologies, economic institutions, cultural practice, military organization, political ideology, and foreign relations.

647. Japan since World War II. (3) Survey of Japanese history since the outbreak of the Pacific War, with emphasis on social and cultural developments. Topics may include occupation and recovery of independence, the "1955 System," high-growth economics, and the problems of prosperity in recent years.

648. Japan since 1800. (3) A survey of Japan in the modern world. Topics include political and cultural revolution, state- and empire-building, economic "miracles," social transformations, military conflicts, and intellectual dilemmas.

650. World Economic History: Globalization, Wealth, and Poverty, 1500-Present. (3) Explores the growth of globalization and its role in the creation of wealth and poverty in both developed and underdeveloped nations. Focuses on trade, industrialization, and agriculture and technological advances in global contexts.

651. Global Environmental History. (3) Analysis of environmental aspects of world history from the beginning of agriculture to the present. Focus on how humans have used the environment to different ends. Topics include forests, agriculture, water, urbanism, science, warfare, conservation, energy, and perceptions of nature.

652. Ten Years of Madness: The Chinese Cultural Revolution, 1966 to 1976. (3) A history of the Chinese Cultural Revolution from 1966 to 1976. Examines the origins, consequences, and collective

memories of the catastrophic political events and the social and cultural transformations that took place in China during the last decade of Mao's leadership.

653. War and Society in Early America. (3) Examines the evolution of warfare among the indigenous and colonial societies of North America between 1500 and 1800 and considers the roles of economics, class, gender, race, religion, and ideology in cultures of violence.

654. Revolutionary and Early National America, 1763-1820. (3) The American Revolution, its causes and effects, the Confederation, the Constitution, and the new nation.

655. History of Nature Conservation in Latin America. (3) Explores the human dimensions of nature conservation in Latin America in a global perspective. Topics include the methods used by different cultures and societies to conserve natural resources (including forests, fields, waterways, and wildlife), the social consequences of environmental protection, and how conservation changed over time. *Taught only in Latin America.*

656. Jacksonian America, 1815-1850. (3) The U.S. in the age of Jackson, Clay, Calhoun, and Webster.

657. The Civil War and Reconstruction. (3) The political and military events of the war and the economic, social, and political readjustments which followed.

659. The U.S. from Gilded Age Prosperity to Depression. (3) Political, social, and economic history of the U.S. from 1877 to 1933 with emphasis on industrialization, urbanization, immigration, growth of Big Business, imperialism, Populism, Progressive reform, war, depression, and race, class and gender relations.

660. The U.S. since the New Deal. (3) Political, social, and economic history of the U.S. since 1933 with emphasis on the Depression, wars at home and abroad, unionism, civil rights movements, counter-cultures, environmentalism, religion, the Imperial Presidency, and liberalism and conservatism.

661. Economic History of the U.S. (3) The economic development of the U.S. from colonial beginnings to the present.

662. American Constitutional History. (3) Origins of the Constitution, the controversies involving the nature of the Union, and constitutional readjustments to meet the new American industrialism.

663. American South and Reconstruction. (3) Examination of the origins of southern distinctiveness, from the first interactions of Europeans, Native Americans, and Africans to the Civil War and Emancipation.

664. The American South since the Civil War. (3) Examination of sharecropping, segregation, political reform, the Sunbelt phenomenon, the Civil Rights Movement, and southern religion, music, and literature. Includes a service learning component.

666. Historic Preservation. (3) Examines the history, legal frameworks, agencies, practices and emerging challenges of historic preservation in the United States and other nations.

668. The Sectional Crisis 1820-1860. (3) Examines the deepening crisis that led to civil war in the U.S., with special attention to politics, culture, reform, economics, and questions of causation, responsibility, or inevitability.

669. Modern Military History. (3) Making war in the modern era, with special attention to the social context of military activity.

- 670. Topics in North Carolina History.** (3) A general chronological survey of North Carolina with emphasis on selected topics. Lectures, readings, and class reports.
- 671. Winston-Salem/Forsyth County.** (3) History of the Winston-Salem/Forsyth County area utilizing the techniques of local history, including local archives, museums, and oral history projects. Lectures, readings, and class projects.
- 674. Protest and Rebellion in Latin America.** (3) Study of the history of protest movements and rebellions in Latin America from primitive and agrarian revolts to mass working class and socialist organizations.
- 676. Civil Rights and Black Consciousness Movements.** (3) A social and religious history of the African-American struggle for citizenship rights and freedom from World War II to the present.
- 677. American Diplomatic History.** (3) Introduction to the history of American diplomacy since 1776, emphasizing the effects of public opinion on fundamental policies.
- 678. Reconciling Race.** (3) Comparative history of 20th-century racial oppression, black rebellion, and religious reconciliation. Also listed as Religion 648.
- 680. America at Work.** (3) Examines the people who built America from 1750 to 1945. Themes include free labor versus slave labor, the impact of industrialization, the racial and gendered realities of work, and the growth of organized labor and its political repercussions.
- 683. Revolution and Culture in Latin America.** (3) Explores the links between revolutionary movements and cultural expression in Latin America and the Caribbean. Includes a Language Across the Curriculum component that allows students to earn credits in Spanish by reading and discussing at least half of the texts in Spanish.
- 687. Islamic Empires Compared: The Ottomans, Safavids, and Mughals.** (3) Examines, in a comparative way, central themes in the history of the three great Islamic empires of the early modern period (1400-1800). Considers the problem of political legitimacy faced by Muslim rulers, transformations in Islamic religious practices, and the relationship between war and other aspects of Islamic society and culture.
- 688. Nation, Faith, and Gender in the Middle East.** (3) Traces the development of nationalism and its interaction with religious, transnational, and gender identities in the Middle East in the 19th and 20th centuries. Topics include Zionism, Arabism, Turkish nationalism, and Islamic revivalism.
- 690. Research Seminar.** (3) Offered by members of the faculty on topics of their choice. A paper is required.
- 691. Honors Seminar.** (3) Seminar on problems of historical synthesis and interpretation. P—POI.
- 692. Individual Research.** (3) Writing of a major research paper. P—POI.
- 693. American Foundations I.** (3) Interdisciplinary study of American art, history, literature, and music. Using its collection of American art as the basis for study, Reynolda House Museum of American Art, in cooperation with Wake Forest University, accepts a limited number of students to study with professors from various disciplines through lectures, discussions, and concerts. Includes a study tour to New York City. (Taught in summer; students enroll for both courses. Students may enroll in either 693 or 763)
- 697. Historical Writing Tutorial.** (1.5) Individual supervision of historical writing to improve a project. P—POI.

698. Individual Study. (3) A project in an area of study not otherwise available in the department; permitted upon departmental approval of petition presented by a qualified student.

699. Directed Reading. (1-3) Concentrated reading in an area of study not otherwise available. P—POI.

763. American Foundations I. (3) Interdisciplinary study of American art, history, literature, and music. Using its collection of American art as the basis for study, Reynolda House Museum of American Art, in cooperation with Wake Forest University, accepts a limited number of students to study with professors from various disciplines through lectures, discussions, and concerts. Includes a study tour to New York City. (Taught in summer; students enroll for both courses. Students may enroll in either 763 or 693).

765. Management of Cultural Organizations. (3) The structure and management of not-for-profit institutions, with emphasis on museums, historical societies and preservation organizations, libraries, archives, and research institutions.

771. Internship. (1, 2, 3) A project involving supervised work in a historical organization or scholarly effort; permitted only upon approval by the graduate committee of a petition presented by a qualified student.

791, 792. Thesis Research. (1-9)

798. Individual Study. (3) A project in an area of study not otherwise available in the department; permitted upon approval by the graduate committee of a petition presented by a qualified student.

HUMANITIES

620. Perspectives on the Middle Ages. (3) A team-taught interdisciplinary course using a variety of literary, historical, and theoretical materials to examine one of the following: a) medieval women; b) medieval constructs of gender, race, and class; c) love and war in the middle ages; d) the medieval environment: landscape and culture. May be repeated for credit with different sub-topics.

653. African and Caribbean Women Writers. (3) Critical analysis of fiction by female authors whose works concern women in Africa and its Caribbean diaspora.

685. Legends of Troy. (3) Interdisciplinary investigation of translations and transformations of the Trojan Legend from the Greeks through the Middle Ages and the Renaissance to the present. Texts, studied in English translation, are by such authors as Homer, Virgil, Ovid, Chaucer, Racine, and Girardoux.

LINGUISTICS

680. Language Use and Technology. (3) Introduction to the fundamental concepts of creating and accessing large linguistic corpora (electronic collections of “real world” text) for linguistic inquiry. Course surveys a variety of cross-discipline efforts that employ corpus data for research and explores current applications.

PHILOSOPHY

631. Plato. (3) Analysis of selected dialogues, covering Plato’s most important contributions to moral and political philosophy, theory of knowledge, metaphysics, and theology. P—POI.

632. Aristotle. (3) Study of the major texts, with emphasis on metaphysics, ethics, and theory of knowledge. P—POI.

- 641. Kant.** (3) Study of selected works covering Kant's most important contributions to theory of knowledge, metaphysics, ethics, religion, and aesthetics. P—POI.
- 642. Studies in Modern Philosophy.** (3) Treatment of selected figures and/or themes in seventeenth and 18th century European philosophy. P—POI.
- 652. Hegel, Kierkegaard, and Nietzsche.** (3) Examination of selected sources embodying the basic concepts of Hegel, Kierkegaard, and Nietzsche, especially as they relate to each other in terms of influence, development, and opposition. P—POI.
- 654. Wittgenstein.** (3) The work of Ludwig Wittgenstein on several central philosophical problems studied and compared with that of Frege, James, and Russell. Topics include the picture theory of meaning, truth, skepticism, private languages, thinking, feeling, the mystical, and the ethical. P—POI.
- 660. Ethics.** (3) Systematic explanation of central ethical theories in the Western philosophical tradition. Such theories include Kantian deontology, utilitarianism, Aristotelian virtue ethics, and divine command theory.
- 661. Topics in Ethics.** (3) P—POI.
- 662. Social and Political Philosophy.** (3) Systematic examination of selected social and political philosophers of different traditions, with concentration on Plato, Marx, Rawls, and Nozick. Topics include rights, justice, equality, private property, the state, the common good, and the relation of individuals to society. P—POI.
- 670. Philosophy and Christianity.** (3) Examination of the philosophical foundations of Christian thought and belief. Christian concepts of God and life everlasting, trinity, incarnation, atonement, prayer, sin, evil, and obligation.
- 671. Philosophy of Art.** (3) Critical examination of several philosophies of art, with emphasis upon the application of these theories to particular works of art. P—POI.
- 672. Philosophy of Religion.** (3) Analysis of the logic of religious language and belief, including an examination of religious experience, mysticism, revelation, and arguments for the nature and existence of God. P—POI.
- 673. Philosophy of Science.** (3) Systematic and critical examination of major views concerning the methods of scientific inquiry, and the bases, goals, and implication of the scientific conclusions which result from such inquiry. P—POI.
- 674. Philosophy of Mind.** (3) Selection from the following topics: the mind-body problem; personal identity; the unity of consciousness; minds and machines; the nature of experience; action, intention, and the will. Readings from classical and contemporary sources. P—POI.
- 675. Philosophy of Language.** (3) Study of such philosophical issues about language as truth and meaning, reference and description, proper names, indexicals, modality, tense, the semantical paradoxes, and the differences between languages and other sorts of sign-systems. P—POI.
- 681. Topics in Epistemology.** (3) The sources, scope, and structure of human knowledge. Topics include: skepticism; perception, memory and reason; the definition of knowledge; the nature of justification; theories of truth. P—POI.
- 682. Topics in Metaphysics.** (3) P—POI.

685. Seminar. (2-3) Offered by members of the faculty on specialized topics of their choice. With permission, may be repeated for credit. P—POI.

POLITICAL SCIENCE

Undergraduate students are given preference in enrollment for courses in the Department of Political Science.

611. Political Parties, Voters, and Elections. (3) Examination of party competition, party organizations, the electorate and electoral activities of parties, and the responsibilities of parties for governing.

617. Politics and the Mass Media. (3) Exploration of the relationship between the political system and the mass media. Two broad concerns are the regulation of the mass media and the impact of media on political processes and events.

618. Congress and Policymaking. (3) Examination of the composition, authority structures, external influences, and procedures of Congress with emphasis on their implications for policymaking in the U.S.

620. The American Presidency. (3) Emphasis on the office and the role; contributions by contemporary presidents considered in perspective.

629. Women and Politics. (3) Examines classical and contemporary arguments regarding the participation of women in politics as well as current policy issues and changes in women's political participation.

631. Western European Politics. (3) Comparative analysis of political institutions, processes, and policy issues in selected West European countries. Special attention will be given to case studies involving Great Britain, France, Germany, Italy, and to the process of European integration.

632. Politics in Russia and Eastern Europe. (3) Analysis of the political, economic, and social patterns of the region emphasizing the internal dynamics of the political and economic transition processes currently underway.

636. Government and Politics in Latin America. (3) Comparative analysis of the institutions and processes of politics in the Latin American region.

646. Politics and Policies in South Asia. (3) Survey of major issues relevant to politics and policy in India, Pakistan, Bangladesh, and Sri Lanka.

647. Islam and Politics. (3) Explores the interrelationship of Islam and politics in the contemporary world. The course has two main foci. The first deals with Islam as a political ideology which shapes the structure of political institutions and behavior. The second looks at Islam in practice by examining the interaction between Islam and the political systems of Iran, Pakistan, Saudi Arabia, and others.

653. International Political Economy. (3) Analyzes major issues in the global political economy including theoretical approaches to understanding the tension between politics and economics, monetary and trade policy, North-South relations, environmentalism, human rights, and democratization.

654. U.S. Foreign Policy: Contemporary Issues. (3) Examination of the most pressing issues in United States foreign policy today, with attention to the historical and institutional context in which U.S. foreign policy is determined.

659. The Arab-Israeli Conflict. (3) Analysis of factors influencing the relationship between Israel and its neighbors relative to fundamental aspects of U.S., Israeli, Palestinian, and Arab states policies.

667. America in Vietnam: Myth and Reality. (3) Analysis of American policy toward Vietnam with special emphasis on the period of 1954–1975. Focus is on the relationship between American policies and the problems posed by Vietnamese and American cultures.

673. Marx, Marxism and the Aftermath of Marxism. (3) Examination of Marx's indebtedness to Hegel, his early humanistic writings, and the vicissitudes of 20th century vulgar Marxism and neo-Marxism in the works of Lenin, Lukacs, Korsch, Horkheimer, Marcuse, and Sartre.

687. Individual Study. (2 or 3) Intensive research leading to the completion of an analytical paper conducted under the direction of a faculty member. Students are responsible for initiating the project and securing the permission of an appropriate instructor. P—POI.

688. Directed Reading. (2 or 3) Concentrated reading in an area of study not otherwise available. Students are responsible for initiating the project and securing the permission of an appropriate instructor. P—POI.

689. Internship in Politics. (2 or 3) Field work in a public or private setting with related readings and an analytical paper under the direction of a faculty member. Students are responsible for initiating the project and securing the permission of an appropriate instructor. Normally one course in an appropriate subfield is taken prior to the internship. P—POI.

ROMANCE LANGUAGES

French

623. Advanced Grammar and Stylistics. (3) Review and application of grammatical structures for the refinement of writing techniques. Emphasis is on the use of French in a variety of discourse types. Attention given to accuracy and fluency of usage in the written language.

629. Introduction to Business French. (3) Introduction to the use of French in business. Emphasizes oral and written practices, reading, and French business culture, as well as a comprehensive analysis of different business topics and areas.

660. Cinema and Society. (3) Study of French and Francophone cultures through cinema. Readings and films may include film as artifact, film theory, and film history.

661. Special Topics in French and Francophone Film Studies. (3) In-depth study of particular aspects of French and/or francophone cinema. Topics may include film adaptations of literary works, cinematographic expressions of social or political issues, selected filmmakers, theories, genres, historical periods, or cinematographic trends. May be repeated for credit when topics vary.

663. Trends in French and Francophone Poetry. (3) Study of the development of the poetic genre with analysis and interpretation of works from each period.

664. French and Francophone Prose Fiction. (3) Survey of French prose fiction, with critical study of several masterpieces in the field.

665. French and Francophone Drama. (3) Study of the chief trends in French dramatic art, with reading and discussion of representative plays from selected periods: Baroque, Classicism, and Romanticism, among others.

670. Seminar in French and Francophone Studies. (3) In-depth study of particular aspects of selected literary and cultural works from different genres and/or periods. Topics vary from semester to semester. May be repeated for credit when topics vary.

674. Topics in French and Francophone Culture. (3) Study of selected topics in French and/or francophone culture. Works will be drawn from different fields (sociology, politics, art, history, music, cinema) and may include journalistic texts, films, historical and other cultural documents. May be repeated for credit when topics vary.

675. Special Topics in French and Francophone Literature. (3) Selected themes and approaches to French literature transcending boundaries of time and genre. May be repeated for credit when topics vary.

681. French Independent Study. (1.5, 3) P—Permission of the department.

Spanish

619. Advanced Grammar and Composition. (3) Advanced-level review of Spanish morphology and syntax applied to the refinement of writing techniques.

621. The Rise of Spanish. (3) The development of Spanish from an early Romance dialect to a world language. Study of ongoing changes in the language's sounds, grammar, and vocabulary system, with a focus on the effects of cultural history and relationships with other languages.

622. Spanish Pronunciation and Dialect Variation. (3) Description of, and practice with, the sounds, rhythm, and intonation of Spanish and the differences from English, with special attention to social and regional diversity. Strongly recommended for improving pronunciation. This course meets a N.C. requirement for teacher certification.

623. Advanced Grammar and Composition. (3) Advanced-level review of Spanish morphology and syntax applied to the refinement of writing techniques.

624. Contrastive Spanish/English Grammar and Stylistics. (3) Advanced study of structure and style in a variety of Spanish texts, with an in-depth approach to idiomatic expressions and some back/cross translation exercises.

629. Special Topics in Hispanic Linguistics. (3) Investigation of key areas in Spanish languages research, such as dialectology, history, language acquisition, and usage.

631. Medieval Spain: A Cultural and Literary Perspective. (3) Examination of the literary, social and cultural themes, such as: Quests and Discoveries, Pilgrimage and the Act of Reading, Images of Islam, The Judaic Tradition in Spanish Literature, and Spiritual Life and Ideal.

632. The Golden Age of Spain. (3) Close analysis of literary texts, such as *Lazarillo de Tormes*, and study of the history of art, politics, and economics of the 16th and 17th centuries, with emphasis on themes such as the writer and society, humanism, the picaresque, Catholic mysticism, and power and politics.

633. 18th- and 19th-Century Spanish Literature and Culture. (3) Study of the major intellectual movements of the period: Enlightenment, Romanticism, Realism, and Naturalism in Spain through literary texts, essays, paintings, and music.

- 634. Voices of Modern Spain.** (3) Study of the multifaceted cultural identity of contemporary Spain through different literary genres, art, and film.
- 635. Modern Spanish Novel.** (3) Study of representative Spanish novels from the Generation of 1898 through the contemporary period.
- 636. Lorca, Dalí, Buñel: An Artistic Exploration.** (3) Study of the relationship of these three Spanish artists through their writings, paintings, and films, respectively, and of their impact on the 20th century.
- 637. Lorca in the 20th Century.** (3) Study of the life and works of poet, playwright, painter, and lecturer Federico García Lorca, within the social, cultural, literary, and artistic realities of the 20th century, including Modernism and Surrealism. Emphasis is on Lorca's treatment of minority cultures, including the Gypsy, the Arab, and homosexuals.
- 638. Love, Death, and Poetry.** (3) Study of the representation of universal themes in Spanish poetry from different historical periods.
- 640. Film Adaptations of Literary Works.** (3) Study of the cinematic and literary discourses through major Spanish literary works from different historical periods and their film adaptation.
- 641. Golden Age Drama and Society.** (3) Study of the theatre and social milieu of 17th-century Madrid, where the works of playwrights such as Lope de Vega, Tirso de Molina, and Calderón de la Barca were performed. Includes analysis of texts and of modern stagings of the plays.
- 643. Cervantes: The Birth of the Novel.** (3) Study of *Don Quijote*, the first modern novel, and several exemplary novels, and contemporary theoretical approaches to them. Considers related art, music, and film. Includes discussion of themes such as the development of prose fiction, the novel as a self-conscious genre, women and society, religion and humanism, nationalism, and imperialism.
- 644. The Debate about Woman in Late Medieval Spain.** (3) Explores romantic love in the Iberian Peninsula in the 14th and 15th centuries focusing on the debate about woman as an index of social changes happening at the moment.
- 645. Medieval Pilgrimages.** (3) Study of pilgrimage as transformative experience. Examines the dual experience of the physical journey, in particular to Santiago de Compostela, and the practice of reading as pilgrimage.
- 649. Special Topics.** (1.5-3) Selected special topics in Spanish literature. P—POI.
- 651. Transatlantic Renaissance.** (3) Study of the Spanish Golden Age period by reading and analyzing relevant peninsular and Colonial texts within the broader political, social and cultural contexts of the Spanish presence in the New World. Exposure to recent critical perspectives in early modern cultural studies.
- 652. Contemporary Theatre in Spain and Spanish America.** (3) Study of contemporary Peninsular and Spanish-American theatre within its political, social, cultural, and aesthetic context.
- 653. Contemporary Women Novelists and their Female Characters.** (3) Study of representative novels by women writers from Spain and Latin America, with emphasis on the representation of the female protagonist within her cultural context.
- 654. Transatlantic Enlightenment.** (3) Study of the Enlightenment in Spain and Spanish America through analysis of texts within broader cultural and political contexts. Readings include primary sources from the 17th through 19th centuries and secondary sources from the late 18th century through current critical reexaminations of the concept of Enlightenment.

655. European-American Encounters, 1492 to the Present. Study of the 500-year tradition of representations of encounter between Spain and the Americas, with special attention to the ways the topic is used to define and redefine individual and collective identities. Primary texts include narratives, plays, engravings, murals, films, and advertisements.

659. Special Topics. (3) Special topics in Transatlantic literature and culture. May be repeated for credit.

660. Colonial Spanish America. (3) Explores the early Spanish-American colonial period alongside contemporary intellectuals' attempt to return to and recover this historical past. Readings include 15th- and 16th-century codices, post-conquest indigenous writings, Iberian chronicles and letters, as well as 20th-century documents.

661. Cultural and Literary Identity in Latin American: From Colonial to Postcolonial Voices. (3) Study of a variety of texts from the 18th and 19th centuries dealing with political emancipation, nation-building, and continental identity.

662. Romantic Nationalism, Avant-garde Nihilism, and the Deconstruction of Utopia. (3) Study of Latin-American poetry, including symbolist, surrealist, and conversational poetry, "happenings," and artistic manifestoes. Politics, nation-building, liberation theology, and love are common themes.

663. Imagined "White" Nations: Race and Color in Latin America. (3) Study of anti-slavery narratives, 19th-century scientific racism, and 20th-century Negritude and "negrismo" movements. Exploration of race, the stratification of color, and ethnic images in Latin-American literature and culture.

664. Transgressing Borders: Identity in the Literature of Latin American and U.S. Latino Cultures. (3) A socio-historical study of theories on culture, sexual politics, and race in relation to literary texts, lyrics of popular music, and art of Latin America and the diaspora.

665. 20th-Century Spanish-American Theater. (3) Study of the Spanish-American dramatic production from the end of the 19th century to the present. Focuses on some of the main dramatic movements of the 20th century: realism, absurdism, avant garde, and collective theater.

666. Latin-American Cinema and Ideology. (3) Examination of major Latin-American films as cinematographic expressions of social and political issues.

667. The Social Canvas of Gabriel García Márquez and Pablo Neruda. (3) Exploration of the techniques used by two Nobel Prize winning writers to create a literary vision of Latin America. Special attention to humor, surrealism, and the grotesque, and both writers' assimilation of personal anxieties to their portrayal of a social world.

668. Spanish-American Short Story. (3) Intensive study of the 20th-century Spanish-American short story with emphasis on major trends and representative authors, such as Quiroga, Rulfo, Borges, Cortázar, Donoso, García Márquez.

669. Spanish-American Novel. (3) Study of the novel in Spanish America from its beginning through the contemporary period.

672. Spanish-American Theatre: From Page to Stage. (3) Study of the transition of a dramatic work from text to performance and the role of Spanish-American theatre as a vehicle for cultural values and sociopolitical issues. Includes rehearsals for the public staging of selected one-act plays. Proficiency in Spanish and willingness to act on stage are required.

673. Literatures of the Mexican Revolution. (3) Explores 20th-century Mexican cultural production as it relates to the Mexican Revolution (1910-1920). Readings include novels, short stories, popular poetry, and historiographic texts. Attention to Mexican muralism and cinema, and special emphasis on relationships between literature, history, and contemporary politics.

679. Special Topics. (1.5, 3) Selected special topics in Spanish-American culture and literature. P—POI.

681. Spanish Translation. (3) Introduces translation strategies through practice, with emphasis on Spanish into English. Focuses on translating in domains such as social science, computing economics, the entertainment industry, banking, and journalism.

682. Spanish/English Interpreting. (1.5, 3) Introduction to strategies of interpreting from Spanish into English, primarily. Intensive lab practice course to develop basic skills in consecutive/escort/simultaneous interpreting. Some voice-over talent training is also included.

687. Spanish for Business. (3) Introduction to Spanish vocabulary and discourse in business. Emphasizes oral and written practices, reading, and Hispanic business culture as well as a comprehensive analysis of different business topics and areas. Two mid-term essays and final essays are required.

LIN 683. Language Engineering: Localization and Terminology. (3) Introduction to the process of making a product linguistically and culturally appropriate to the target locale, and to computer-assisted terminology management. Surveys applications in translation technology. Taught in English. P—POI.

684. Internships for Spanish Translation/Localization and Spanish Interpreting. (1.5-3) Under faculty supervision, a student undertakes a translation/interpreting project at a translation bureau or translation department of a company/public organization. A community service-oriented internship is preferred for interpreting.

SOCIOLOGY

634. Sociology of Education. (3h) An evaluation of the major theories and significant empirical literature, both historical and statistical, on the structure and effects of educational institutions.

635. Sociology of Health and Illness. (3) Analysis of the social variables associated with health and illness.

637. Aging in Modern Society. (3) Basic social problems and processes of aging. Social and psychological issues discussed. Course requirements include field placement in a nursing home or similar institution. P—POI.

643. Sociology of Law. (3) Consideration is given to a variety of special issues: conditions under which laws develop and change, relationships between the legal and political system, the impact of social class and stratification upon the legal order.

660. Social Inequality. (3) Study of structured social inequality with particular emphasis on economic class, social status, and political power.

662. Work, Conflict, and Change. (3) Examination of the changing trends in the U.S. labor force, the individual's view of work, and the effect of large organizations on white- and blue-collar workers. Use of some cross-cultural data.

663. Global Capitalism. (3) Analysis of industrial organization, including discussion of market relations and the behavior of firms, the structure of industrial development, and labor relations and the growth of trade unions.

WOMEN'S AND GENDER STUDIES PROGRAM

Undergraduate students are given preference in enrollment for courses in the Women's and Gender Studies Program.

620. Introduction to Women's and Gender Studies. (3) Interdisciplinary course, taught by women's and gender studies faculty representing at least two fields, that integrates materials from the humanities and the sciences. Topics include critical methods and practical solutions, gender issues in the 21st century, women in culture and society, and cross-cultural issues of gender, ethnicity, social class, disability, and sexual orientation.

621. Interdisciplinary Seminar. (3) Research-centered study of questions raised by women's and gender studies on an interdisciplinary topic, such as women's health issues, international women's issues, perspectives on women and aging, lesbian and gay culture and theory, and women in the arts.

658. Mothers and Daughters: Literature and Theory. (3) Examines literature and feminist theories on motherhood and the mother-daughter relationship. Writers to be studied include Morrison, Rich, Allison, Danticat, and Walker. A cross-cultural perspective is taken.

677. Special Topics: Gender and Islam. (3) Considers the complicated relationship between gender, Islam, and identity, paying special attention to how gender roles are enacted, resisted, or transformed in relation to Islam. For example, the class will investigate how veiling informs women's identities in both Islamic and secular nations. Drawing on ethnographic accounts, students explore the intersection of gender and Islam in daily life and its theological implications.

696. Independent Study. (1-3) Independent projects in women's studies, which either continue study begun in regular courses or develop new areas of interest. By prearrangement.

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Assistant Secretary: Anita M. Conrad, *Winston-Salem, NC*

The Graduate Council (3-year terms)

(Expires)

Dr. Lorna Moore	Dean	lmoore@wakehealth.edu	
Dr. Dwayne Godwin	Associate Dean	dgodwin@wakehealth.edu	2013
Dr. Brad Jones	Associate Dean	jonesbt@wfu.edu	2013
Dr. Susan Fahrbach	Biology	fahrbach@wfu.edu	2012
Dr. Ann Geiger	PHS-Epidemiology	ageiger@wakehealth.edu	2013
Dr. Donna Henderson	Counseling	henderda@wfu.edu	2014
Dr. Steven Kridel	Cancer Biology	skridel@wakehealth.edu	2012
Dr. Abdou Lachgar	Chemistry	lachgar@wfu.edu	2014
Dr. Anthony Liguori	Physiology and Pharmacology	aliguori@wakehealth.edu	2012
Dr. Allan Loudon	Communication	louden@wfu.edu	2013
Dr. Fred Perrino	Biochemistry	fperrino@wakehealth.edu	2014
Dr. Fred Salisbury	Physics	salsbufr@wfu.edu	2013
Dr. Greg Shelness	Pathology	gshelnes@wakehealth.edu	2014
Dr. Mike Tytell	Neurobiology and Anatomy	mtytell@wakehealth.edu	2013
Dr. Eric Wilson	English	wilsoneg@wfu.edu	2012

Graduate Faculty Representatives to the University Senate (4-year terms)

Dr. David Anderson	Biology	djanders@wfu.edu	2013
Dr. Greg Kucera	Internal Medicine	gkucera@wakehealth.edu	2011
Dr. Alan Townsend	Biochemistry	atown@wakehealth.edu	2014

The Graduate Faculty

Date following name indicates year of appointment to the graduate faculty. Faculty are listed with their primary and joint appointments only. For information on cross appointments, secondary appointments, and center affiliations, visit <http://graduate.wfu.edu/faculty/directory.html>

Tamer Aboushwareb (2010)	Assistant Professor, Institute for Regenerative Medicine
MB-Bch, MS, MD, Medical School at Ain Shams University (Egypt)	
Azeez A. Aileru (2000)	Adjunct Associate Professor, Physiology and Pharmacology
BS, MS, North Carolina Central; PhD, Howard University College of Medicine	
Steven A. Akman (1996)	Professor, Internal Medicine (Hematology/Oncology)
AB, Cornell; MD, Albert Einstein College of Medicine	Joint Appointment: Cancer Biology
Rebecca Wagner Alexander (2001)	Associate Professor, Chemistry
BS, University of Delaware; PhD, University of Pennsylvania	
Martha Alexander-Miller (1997)	Associate Professor, Microbiology and Immunology
BS, Butler; PhD, Washington	
Edward E. Allen (1991)	Professor, Mathematics
BS, Brigham Young; MA, PhD, California (San Diego)	
Graça Almeida-Porada (2011)	Professor, Institute for Regenerative Medicine
MD, PhD, School of Medicine, University of Porto (Portugal)	
Walter Ambrosius (2003)	Professor, Public Health Sciences
AB, AM, Washington; PhD, University of Chicago	(Biostatistical Sciences)
David J. Anderson (1992)	Professor, Biology
BA, Denison; MS, Michigan; PhD, Pennsylvania	
John P. Anderson (1984)	Professor, Counseling
BS, MS, PhD, Georgia Institute of Technology; MBA, Alabama (Birmingham)	
Paul R. Anderson (1990)	Professor, Physics
BS, Wisconsin (Madison); MA, PhD, University of California (Santa Barbara)	
Karl-Erik Andersson (2009)	Professor, Institute for Regenerative Medicine
MD, University of Lund (Sweden)	
Peter Antinozzi (2007)	Assistant Professor, Biochemistry
BSc, University of Florida; PhD, University of Texas	Joint Appointment: Center for Genomics and Personalized Medicine Research
Susan E. Appt (2008)	Assistant Professor, Pathology/Comparative Medicine
BS, Nova Scotia Agricultural College (Truro, Nova Scotia) PhD, Atlantic Veterinary College (Charlottetown, Prince Edward Island)	
Thomas Arcury (2004)	Professor and Research Director, Family & Community Medicine
BA, Duquesne; MA, PhD, University of Kentucky	
Miriam A. Ashley-Ross (1997)	Associate Professor, Biology
BS, Northern Arizona; PhD, University of California (Irvine)	
Anthony Atala (2004)	Professor, Surgical Sciences (Urology)
BA, University of Miami; MD, University of Louisville	
Robert Jarrod Atchison (2011)	Assistant Professor, Communications
BA, MA, Wake Forest; PhD, University of Georgia	

Craig Atwood (2010)	John Comenius Adjunct Professor of Theology, Divinity
BA, University of Miami; MD, University of Louisville	
Nancy Avis (2001)	Professor, Public Health Sciences
BA, University of Wisconsin;	(Social Sciences and Health Policies)
MA, University of Illinois at Chicago Circle;	
PhD, University of Michigan; MSHyg, University of Pittsburgh School of Public Health	
Wanda Balzano (2007)	Program Director and Adjunct Assistant Professor,
BA, MA, University of Naples, Italy;	Women's and Gender Studies
MA, PhD, University College, Dublin	
Erik S. Barton (2011)	Assistant Professor, Microbiology and Immunology
BA, Baylor; PhD, Vanderbilt	
Alessandra Beasley (2006)	Assistant Professor, Communications
BA, Arizona State; MA, PhD, Pittsburgh	
Bettina M. Beech (2009)	Professor, Public Health Sciences (Social Sciences and Health Policy)
BA, MPH, Temple; PhD, University of Texas	
S. Douglas Beets (2010)	Professor, Schools of Business
BS, University of Tennessee;	
MA, PhD, Virginia Polytechnic Institute and State University	
Ronny A. Bell (1998)	Professor, Public Health Sciences (Epidemiology & Prevention)
BS, UNC-Chapel Hill;	Joint Appointment: Public Health Sciences
MS, Wake Forest; MEd, PhD, UNC-Greensboro	(Social Sciences and Health Policy)
Allyson J. Bennett (2003)	Assistant Professor, Physiology and Pharmacology
BS, University of Wisconsin (Oshkosh);	
MS, PhD, University of Memphis	
Kenneth Berenhaut (2001)	Associate Professor, Mathematics
BA, MS, University of Manitoba; MA, PhD, University of Georgia	
Isabelle M. Berquin (2002)	Assistant Professor, Cancer Biology
BS, Free University of Brussels; PhD, Wayne State	
Michael J. Berry (1985)	Professor, Health and Exercise Science
BS, Jacksonville State;	
MA, Southeastern Louisiana; PhD, Texas A&M	
Alain G. Bertoni (2002)	Associate Professor, Public Health Sciences (Epidemiology & Prevention)
BA, Yale; MPH, MD, Johns Hopkins	
Deborah L. Best (1972)	William L. Poteat Professor, Psychology
BA, MA, Wake Forest; PhD, UNC-Chapel Hill	
Thomas Beveridge (2010)	Assistant Professor, Physiology and Pharmacology
BSc, University of the West England (UK);	
MSc, Bristol University (UK); PhD, DeMontfort University (UK)	
Ulrich Bierbach (2000)	Associate Professor, Chemistry
MS, PhD, University of Oldenburg	
Werner E. Bischoff (2007)	Assistant Professor, Internal Medicine (Infectious Disease)
MA, MD, Medical School Georg-August (Göttingen, Germany)	
MS, Wake Forest; PhD, UNC-Chapel Hill	
Colin Bishop (2007)	Professor, Institute for Regenerative Medicine
BSc, University of Wales (Aberystwyth);	
MSc, University of Brunel (England); PhD, University of London (England)	
Eugene Bleecker (2003)	Professor, Center for Genomics and Personalized Medicine Research
BA, NY University;	Joint Appointment: Internal Medicine (Pulmonary/Critical Care Medicine)
MD, State University of NY, Downstate Medical Center	

Robert Bliss (2006)	Professor and F.M. Kirby Chair, Schools of Business
BS, Purdue; MBA, PhD, University of Chicago	
Terry D. Blumenthal (1987)	Professor, Psychology
BSc, Alberta; MS, PhD, Florida University	
Keith D. Bonin (1992)	Professor, Physics
BS, Loyola (New Orleans); PhD, Maryland (College Park)	
Susan Harden Borwick (1982)	Professor, Music
BM, BME, Baylor; PhD, UNC-Chapel Hill	
J. Daniel Bourland (1995)	Associate Professor, Radiation Oncology
BS, MSPH, PhD, UNC-Chapel Hill	
Donald W. Bowden (1989)	Professor, Biochemistry
BA, Vanderbilt; PhD, University of California (Berkeley)	Joint Appointment: Center for Genomics and Personalized Medicine Research
Rian Elizabeth Bowie (2009)	Assistant Professor, English
BA, Tougaloo College; MA, Temple; PhD, Emory	
Stephen B. Boyd (1986)	John Allen Easley Professor, Religion
BA, Tennessee; MDiv, ThD, Harvard Divinity School	
Anne M. Boyle (1997)	Professor, English
BA, Wilkes College; MA, PhD, University of Rochester	
Gretchen A. Brenes (2010)	Associate Professor, Psychiatry
BS, Louisiana State; MA, PhD, Washington University (St. Louis)	
Linda McKinnish Bridges (2009)	Associate Director of Admissions
BA, Meredith; MDiv, PhD, Souther Baptist Theological Seminary; MBA, Wake Forest	
K. Bridget Brosnihan (1993)	Professor, Surgical Sciences (General)
BS, College of St. Mary; MS, Creighton; PhD, Case Western Reserve	Joint Appointment: Institute for Regenerative Medicine
Michaëlle L. Browsers (2007)	Associate Professor, Political Science
BA, Whitman; MA, Virginia; PhD, Minnesota	
Jonathan Mark Brown (2009)	Assistant Professor, Pathology (Lipid Sciences)
BS, PhD, UNC-Greensboro	
Carole L. Browne (1980)	Professor, Biology
BS, Hartford; PhD, Syracuse	
Robert A. Browne (1980)	Professor, Biology
BS, MS, Dayton; PhD, Syracuse	
Peter H. Brubaker (1991)	Professor, Health and Exercise Science
BS, East Stroudsburg; MA, Wake Forest; PhD, Temple	
Peter Brunette (2005)	Reynolds Professor of Film Studies, Art and Communication
BA, MA, Duquesne; PhD, University of Wisconsin	
Christy M. Buchanan (1992)	Professor, Psychology
BA, Seattle Pacific; PhD, Michigan	
Jonathan Burdette (2003)	Associate Professor, Diagnostic Radiology
BSE, Duke; MD, University of Tennessee	
Jennifer J. Burg (1993)	Professor, Computer Science
BA, Elizabethtown College; MA (French), MA (English), Florida; PhD, Central Florida	
Gregory L. Burke (1991)	Professor, Public Health Sciences
BA, Northern Iowa; MS, MD, Iowa	

Robert P. Byington (1987)	Professor, Public Health Sciences (Epidemiology & Prevention)
BS, Loyola; MPH, PhD, Texas (School of Public Health)	
William S. Caldwell (1994)	Adjunct Assistant Professor, Physiology and Pharmacology
BS, University of the South; PhD, Wisconsin	Targacept, Inc.
Daniel A. Cañas (1987)	Associate Professor, Computer Science
BS, Tecnológico de Monterrey (Mexico); MS, Georgia Tech; PhD, Texas (Austin)	
Eric D. Carlson (1995)	Associate Professor, Physics
BS, Michigan State; PhD, Harvard	
Richard D. Carmichael (1971)	Professor, Mathematics
BS, Wake Forest; MA, PhD, Duke	
Simone M. Caron (1991)	Associate Professor, History
BA, Bridgewater State; MA, Northeastern; PhD, Clark	
John Jeffrey Carr (2007)	Professor, Diagnostic Radiology
BA, MD, Vanderbilt; MS, Wake Forest	
David Carroll (2003)	Professor, Physics
BA, University of Colorado; PhD, UNC-Chapel Hill	
L. Douglas Case (1986)	Professor, Public Health Sciences (Biostatistical Sciences)
BS, MSPH, PhD, UNC-Chapel Hill	
Mark Chappell (1997)	Professor, Surgical Sciences (General)
BA, American; PhD, Cleveland State	
Haiying Chen (2005)	Assistant Professor, Public Health Sciences (Biostatistical Sciences)
Bachelor of Medicine, Master of Medicine, Shanghai Medical University (PR China); MS, PhD, Ohio State	
Yong Q. Chen (2002)	Professor, Cancer Biology
BS, Fudan University (PR China); PhD, Free University of Brussels	
Che-Ping Cheng (1993)	Professor, Internal Medicine (Cardiology)
MD, Nanjing Railway Medical University (PR China); PhD, Wayne State	
Martin K. Childers (2006)	Professor, Neurology
BA, Seattle Pacific; DO Western; PhD, University of Missouri (Columbia)	
Steven R. Childers (1990)	Professor, Physiology and Pharmacology
BS, Texas (Austin); PhD, Wisconsin (Madison)	
Floyd H. Chilton (1998)	Professor, Physiology and Pharmacology
BS, Western Carolina; PhD, Wake Forest	
Samuel Cho (2010)	Assistant Professor, Physics/Computer Science
BS, University of Maryland (Baltimore County); PhD, University of California (San Diego)	
George Christ (2004)	Professor, Institute for Regenerative Medicine
BS, Muhlenberg College; PhD, Wake Forest	
H. Alexander Claiborne Jr. (1983)	Professor, Biochemistry
BA, Vanderbilt; PhD, Duke	
Thomas B. Clarkson Jr. (1957)	Professor, Pathology (Comparative Medicine)
DVM, Georgia	
J. Mark Cline (1993)	Professor, Pathology (Comparative Medicine)
BS, DVM, PhD, North Carolina State	

David Coates (2007)	Worrell Professor of Anglo-American Studies, Political Science
BA, York; PhD, Oxford	
Robert C. Coghill (1999)	Associate Professor, Neurobiology and Anatomy
BS, College of William and Mary; PhD, Virginia Commonwealth	
Laura H. Coker (2002)	Associate Professor, Public Health Sciences
BSN, MSN, PhD, UNC-Greensboro	(Social Sciences and Health Policies)
Christa L. Colyer (1997)	Professor, Chemistry
BS, Trent University, Canada;	
MS, University of Guelph, Canada; PhD, Queen's University (Canada)	
Lindsay Comstock (2008)	Assistant Professor, Chemistry
BS, Northern Arizona; PhD, University of Wisconsin (Madison)	
William E. Conner (1988)	Professor, Biology
BA, Notre Dame; MS, PhD, Cornell	
Christos Constantinidis (2003)	Associate Professor, Neurobiology and Anatomy
BS, University of Athens (Greece); PhD, Johns Hopkins	
Gregory Cook (2000)	Associate Professor, Physics
BS, PhD, UNC-Chapel Hill	
Christine Nero Coughlin (2009)	Professor, Legal Research and Writing
JD, Wake Forest	Bioethics
Sonia J.S. Crandall (2004)	Professor, Family and Community Medicine
BS, Western Illinois; MEd, University of Illinois;	Joint Appointment: Institute for Regenerative Medicine
MS, Wake Forest ; PhD, University of Oklahoma	
Zheng Cui (1996)	Associate Professor, Pathology (Tumor Biology)
Degree in Medicine, Tsuenyi Medical College (PR China);	Joint Appointment: Institute for Regenerative Medicine
MS, Shanghai Institute of Entomology, Chinese Academy of Sciences (PR China);	
PhD, Massachusetts (Amherst)	
Ann Cunningham (2009)	Associate Professor, Education
BA, Erskine College; MAT, PhD, University of South Carolina, Columbia	
James F. Curran (1988)	Professor, Biology
BAAS, Delaware; MA, PhD, Rice	
Paul Czoty (2003)	Assistant Professor, Physiology and Pharmacology
BS, Notre Dame; PhD, Emory	
Dale Dagenbach (1990)	Professor, Psychology
BA, New College; MA, PhD, Michigan State	
Ralph B. D'Agostino Jr. (1996)	Professor, Public Health Sciences (Biostatistical Sciences)
AB, Bowdoin College; AM, PhD, Harvard	
Mary M. Dalton (1996)	Associate Professor, Communication
BA, Wake Forest; MA, PhD, UNC-Greensboro	
Suzanne Danhauer (2008)	Assistant Professor, Internal Medicine/Hematology and Oncology
BS, University of Illinois;	
MS, PhD, University of Kentucky	
Larry W. Daniel (1982)	Professor, Biochemistry
BS, MS, Western Kentucky; PhD, Tennessee (Memphis)	
James B. Daunais (1999)	Assistant Professor, Physiology and Pharmacology
BS, PhD, East Carolina	
Rafael Vidal Davalos (2007)	Assistant Professor, Biomedical Engineering
BS, Cornell; MS, PhD, California (Berkeley)	

Lisa David (2003) BS, Indiana Wesleyan; MD, Indiana University School of Medicine	Associate Professor, Surgical Sciences (Plastic and Reconstructive Surgery)
Arlene Davis (2010) BSN, South Dakota State University; JD, University of Washington	Adjunct, Department of Social Medicine UNC-Chapel Hill
Paul A. Dawson (1991) BS, Florida; PhD, SUNY (Stony Brook)	Professor, Internal Medicine (Gastroenterology)
Samuel A. Deadwyler (1977) BA, San Diego State; PhD, SUNY (Stony Brook)	Professor, Physiology and Pharmacology
J. Donald deBethizy (1994) BS, MS, PhD, Utah State	Adjunct Professor, Physiology and Pharmacology Targacept Inc.
Waldemar Debinski (2004) BSc, 2nd Royal Gymnasium S. Batory (Warsaw); MD, Warsaw Medical School (Warsaw); PhD, McGill	Professor, Surgical Sciences (Neurosurgery)
Osvaldo Delbono (1994) MD, PhD, Buenos Aires School of Medicine (Argentina)	Professor, Internal Medicine (Gerontology)
Rajendar K. Deora (2004) BSc, MSc, University of Calcutta (India); PhD, University of Illinois	Assistant Professor, Microbiology and Immunology
Mary K. DeShazer (1988) BA, Western Kentucky; MA, Louisville; PhD, Oregon	Professor, English and Women's and Gender Studies
Sandra Dickson (2009) BS, Mississippi College; MA, University of West Florida; PhD, Florida State	Professor, Communication
Ronald V. Dimock Jr. (1970) BA, New Hampshire; MS, Florida State; PhD, University of California (Santa Barbara)	Thurman D. Kitchin Professor, Biology
Jasmin Divers (2009) MS, PhD, SUNY (Stony Brook)	Assistant Professor, Public Health Sciences (Biostatistical Sciences)
Debra I. Diz (1970) BA, Randolph-Macon; PhD, University of Tennessee	Professor, Surgical Sciences (General)
Patricia Dos Santos (2008) BS, Universidade Federal do Rio Grande do Sul (Porto Alegre, Brazil) PhD, Virginia Tech	Assistant Professor, Chemistry
Purnima Dubey (2004) AB, PhD, University of Chicago	Assistant Professor, Pathology (Tumor Biology)
Thomas D. DuBose Jr. (2003) BS, University of Alabama; MD, University of Alabama (Birmingham)	Professor, Internal Medicine (Nephrology)
Jonathan Duchac (2009) BBA, MAcc, University of Wisconsin-Madison; PhD, University of Georgia	Merrill Lynch Associate Professor of Accountancy, Schools of Business
Stefan M. Duma (2006) BS, University of Tennessee; MS, University of Cincinnati; PhD, University of Virginia	Associate Professor, Mechanical Engineering (Virginia Tech) VT/WFU School of Biomedical Engineering & Sciences
Doug Easterling (2004) BA, Carleton College; MA, UNC-Chapel Hill; PhD, University of Pennsylvania, Wharton School	Associate Professor, Public Health Sciences (Social Sciences & Health Policy)
Delrae M. Eckman (2003) BA, University of Arizona; PhD, University of Nevada (Reno)	Assistant Professor, Pediatrics

Julie Edelson (2001)	Adjunct Assistant Professor, Liberal Studies Program (English)
BA, Sarah Lawrence College; PhD, Cornell	
Iris J. Edwards (1993)	Associate Professor, Pathology (Tumor Biology)
BA, High Point; PhD, Wake Forest	
James C. Eisenach (1987)	Professor, Anesthesiology
BA, Nebraska; MS, California Institute of Technology; MD, University California	
J. Charles Eldridge (1978)	Professor, Physiology and Pharmacology
BA, North Central; MS, Northern Illinois; PhD, Medical College of Georgia	
Jennifer Erway (2009)	Assistant Professor, Mathematics
BA, Claremont McKenna College; MA, PhD, University of California, San Diego	
Gerald W. Esch (1965)	Charles M. Allen Professor, Biology
BS, Colorado College; MS, PhD, Oklahoma	
Paul D. Escott (1988)	Reynolds Professor, History
BA, Harvard; MA, PhD, Duke	
Mark A. Espeland (1986)	Professor, Public Health Sciences (Biostatistical Sciences)
BS, Arizona; MA, PhD, Rochester	
Andrew V. Ettin (1977)	Professor, English
BA, Rutgers; MA, PhD, Washington	
Herman E. Eure (1974)	Professor, Biology
BS, Maryland State; PhD, Wake Forest	
Gregory W. Evans (1996)	Assistant Professor, Public Health Sciences (Biostatistical Sciences)
BA, MA, Missouri	
Susan Elizabeth Fahrback (2004)	Reynolds Professor of Developmental Neuroscience, Biology
BA, University of Pennsylvania; BA, Oxford (St. Hilda's College); PhD, The Rockefeller University	
Alan Christopher Farney (2009)	Professor, Surgical Sciences (General Administration)
BA, Haverford College; MD, University of Rochester; PhD, University of Minnesota	
Steven R. Feldman (1993)	Professor, Dermatology
BA, Chicago; PhD, Duke	
Xin Feng (2010)	Assistant Professor, Surgical Sciences (Otolaryngology)
MS, MD, Qingdao University (PR China); PhD, Peking University (PR China)	
Christin M. Ferguson (2007)	Assistant Professor, Surgical Sciences (Orthopedic)
BS, MD, Michigan (Ann Arbor)	
Carlos M. Ferrario (1993)	Professor, Surgical Sciences (General)
MD, Buenos Aires (Argentina)	
Jacquelyn Fetrow (2003)	Reynolds Professor, Physics and Computer Science
BS, Albright College; PhD, Pennsylvania State University College of Medicine	
Jorge P. Figueroa (1990)	Professor, Obstetrics and Gynecology (Maternal/Fetal)
MD, Chile; PhD, Cornell	
William W. Fleeson (1996)	Professor, Psychology
BA, Wisconsin; PhD, Michigan	
D. Lynn Flowers (2003)	Adjunct Assistant Professor, Neurology (Neuropsychology)
BA, MA, PhD, UNC-Greensboro	

Steven Folmar (1992)	Assistant Professor, Anthropology
BA, MA, PhD, Case Western Reserve	
James L. Ford (1998)	Associate Professor, Religion
BA, UNC-Chapel Hill; MTS, Vanderbilt; MA, PhD, Princeton	
Mary F. Foskett (1997)	Associate Professor, Religion
BA, New York; MDiv, Union Theological Seminary; PhD, Emory	
Capri G. Foy (2005)	Assistant Professor, Public Health Sciences (Social Sciences and Health Policy)
BA, UNC-Chapel Hill; MEd, University of Virginia; MS, Wake Forest; PhD, UNC-Greensboro	
Dean J. Franco (2002)	Associate Professor, English
BA, University of California (Irvine); MA, California State University; PhD, University of Southern California	
Joseph W. Freeman (2007)	Assistant Professor, Biomedical Engineering
BSE, Princeton; PhD, Rutgers	
Adam Friedman (2009)	Associate Professor, Education/Social Studies
BA, SUNY, College at Geneseo; MAEd, PhD, University of Virginia	
David P. Friedman (1991)	Professor, Physiology and Pharmacology
BS, Pittsburgh; MS, PhD, New York Medical College	
Jacqueline Friedman (2010)	Adjunct Faculty, Psychology
BA, College of William & Mary; MA, PhD, University of Virginia	
Errin W. Fulp (2002)	Associate Professor, Computer Science
BS, MS, PhD, North Carolina State	
Curt D. Furberg (1986)	Professor, Public Health Sciences
MD, PhD, University of Umea (Sweden)	
Cristina Furdui (2007)	Assistant Professor, Internal Medicine (Molecular Medicine)
BS, MS, Babes-Bolyai University (Romania); PhD, Nebraska	
Olgierda Furmanek (2009)	Associate Professor, Romance Languages
MA, Jagiello University (Cracow, Poland); PhD, University of Nebraska (Lincoln)	
R. Michael Furr (2005)	Associate Professor, Psychology
BA, College of William and Mary; MS, Villanova; PhD, University of California (Riverside)	
H. Clay Gabler (2007)	Professor, Biomedical Engineering
BS, ME, Virginia; MA, PhD, Princeton	
H. Donald Gage Jr. (1999)	Assistant Professor, Diagnostic Radiology
BA, South Florida; MS, PhD, North Carolina State	
Patricia E. Gallagher (2009)	Associate Professor, Surgical Sciences (Hypertension & Vascular Disease Ctr)
BS, MS, Memphis State; PhD, University of Tennessee	
Pradeep Garg (2004)	Professor, Diagnostic Radiology
BS, MS, Kurukshetra University (India); PhD, Lucknow University (India)	
Paul Gatenholm (2008)	Professor, Biomedical Engineering
BSc, University of Stockholm; PhD, Chalmers (Sweden)	
Yaeorng Ge (1995)	Assistant Professor, Biomedical Engineering
BS, Graduate Diploma, Zhejiang (PR China); MS, PhD, Vanderbilt	VT/WFU School of Biomedical Engineering and Sciences
Randolf L. Geary (2004)	Professor, General Surgery
BS, University of Idaho; MD, University of Washington	

Ann Geiger (2006) AB, Harvard-Radcliffe College; MPH, PhD, University of Michigan (Ann Arbor)	Associate Professor, Public Health Sciences (Social Sciences Health Policy)
Cynthia Gendrich (2010) BFA, Illinois Wesleyan; MA, PhD, University of Missouri (Columbia)	Professor, Theatre
Steven Giles (2002) BA, Northern Kentucky; MA, Bowling Green State; PhD, University of Kentucky	Associate Professor, Communication
Michele K. Gillespie (2000) BA, Rice; PhD, Princeton	Kahle Professor of History
Samuel T. Gladding (1990) BA, MAEd, Wake Forest; MA, Yale; PhD, UNC-Greensboro	Professor, Counseling
William H. Gmeiner (2002) BS, University of Chicago; PhD, University of Utah	Professor, Cancer Biology
Dwayne Godwin (1997) BA, University of West Florida; PhD, University of Alabama (Birmingham)	Professor, Neurobiology and Anatomy Joint Appointment: Institute for Regenerative Medicine
David C. Goff Jr. (1996) BS, Duke; MD, UNC-Chapel Hill; PhD, Texas (Houston)	Professor, Public Health Sciences (Epidemiology & Social Sciences and Health Policy)
Aaron S. Goldstein (2008) BS, University of California (Berkeley); PhD, Carnegie Mellon	Associate Professor, Biomedical Engineering
William Gordon (2010) BA, MA, Wake Forest; PhD, Rutgers	Professor, Psychology
Jason M. Grayson (2002) BS, University of Maryland; PhD, University of Texas (Dallas)	Associate Professor, Microbiology and Immunology
Leanne Groban (2007) BS, Wisconsin (Madison); MS, Wisconsin (Milwaukee); MD, Medical College of Wisconsin	Associate Professor, Anesthesiology
Martin Guthold (2003) Vordiplom (Bachelor), Universitat Ulm (Germany); MA, PhD, University of Oregon	Associate Professor, Physics Joint Appointment: Institute for Regenerative Medicine
Karen Haas (2010) BA, Saint Mary's University of Minnesota; PhD, University of Missouri (Columbia)	Assistant Professor, Microbiology and Immunology
Mark A. Hall (1996) BA, Middle Tennessee State; JD, University of Chicago Law School	Professor, Public Health Sciences (Social Sciences Health Policy)
Craig A. Hamilton (1993) BS, Georgia Tech; MS, PhD, North Carolina State	Associate Professor, Biomedical Engineering
William S. Hamilton (1986) BA, MA, PhD, Yale	Professor, German and Russian
Robert E. Hampson (1993) BS, Texas University (San Antonio); MS, Lehigh; PhD, Wake Forest	Associate Professor, Physiology and Pharmacology
Carnell J. Hampton (2006) BS, South Carolina State; PhD, Wake Forest	Assistant Professor, Radiation Oncology
Annegret Hannawa (2009) BA, MA, San Diego State; PhD, Arizona State	Assistant Professor, Communication
James S. Hans (1982) BA, MA, Southern Illinois; PhD, Washington (St. Louis)	Charles E. Taylor Professor, English

Kimberley J. Hansen (2008)	Professor, Surgical Sciences—Vascular
BS, Birmingham Southern College;	Joint Appointment: Urology
MD, University of Alabama School of Medicine	
Roy R. Hantgan (1983)	Associate Professor, Biochemistry
BS, Juniata; PhD, Cornell	
Hannah Hardgrave (2010)	Lecturer, Philosophy
AB, Brown; MA, PhD, University of Chicago	
Susan Harlan (2010)	Assistant Professor, English
BA, Columbia; MA, King's College London (England);	
MA, PhD, New York University	
Katy J. Harriger (2005)	Professor, Political Science
BA, Edinboro State; MA, PhD, Connecticut	
Benjamin S. Harrison (2007)	Assistant Professor, Institute for Regenerative Medicine
BS, University of West Florida; PhD, University of Florida	
Karen Haas (2010)	Assistant Professor, Microbiology and Immunology
BA, Saint Mary's University of Minnesota;	
PhD, University of Missouri (Columbia)	
Nathan O. Hatch (2005)	President, Wake Forest University
AB, Wheaton; AM, PhD Washington	
Angela Hattery (2004)	Professor, Sociology
BA, Carleton College; MS, PhD, University of Wisconsin (Madison)	
Gregory A. Hawkins (2003)	Associate Professor, Center for Genomics and Personalized Medicine
BA, UNC-Chapel Hill;	Joint Appointment: Internal Medicine
PhD, University of Maryland (College Park)	
Satoru Hayasaka (2005)	Assistant Professor, Public Health Sciences (Biostatistics)
BS, Concordia, Montreal, Canada;	
MS, PhD, University of Michigan (Ann Arbor)	
Michael David Hazen (1974)	Professor, Communication
BA, Seattle Pacific; MA, Wake Forest; PhD, Kansas	
Ashok N. Hegde (2002)	Associate Professor, Neurobiology and Anatomy
BS, MS, University of Bangalore (India);	
PhD, Centre for Cellular and Molecular Biology, (India)	
Gary M. Hellmann (2004)	Adjunct Associate Professor, Physiology and Pharmacology
BA, Michigan State; MA, Eastern Michigan;	FirmLogic LLC
PhD, University of Kentucky	
Scott Edwards Hemby (2004)	Professor, Physiology and Pharmacology
BS, Barton College; MA, Emory; PhD, Wake Forest	
Omaar Hena (2010)	Assistant Professor, English
BA, Wake Forest; MA, University of College Dublin (Ireland);	
PhD, University of Virginia	
Donna A. Henderson (1997)	Associate Professor, Counseling
BA, Meredith College; MA, James Madison; PhD, Tennessee State	
Craig K. Henkel (1978)	Professor, Neurobiology and Anatomy
BS, Wheaton College; PhD, Ohio State	
David M. Herrington (1990)	Professor, Internal Medicine (Cardiology)
BS, Davidson; MD, UNC-Chapel Hill; MHS, Johns Hopkins	
Kevin P. High (1999)	Associate Professor, Internal Medicine (Infectious Diseases)
BS, Bucknell; MS, Wake Forest;	Joint Appointment: Institute for Regenerative Medicine
MD, University of Virginia	

Cynthia L. Hill (2011)	Lecturer, Communication
BA, MA, University of West Florida	
Michael Hill (2005)	Assistant Professor, English
BA, Howard; MA, PhD, Harvard	
Yvonne Hinson (1997)	Associate Professor, Business and Accountancy
BS, MBA, UNC-Charlotte; PhD, University of Tennessee	
Willie L. Hinze (1975)	John B. White Professor, Chemistry
BS, MA, Sam Houston State; PhD, Texas A&M	
Steve Hodges (2009)	Assistant Professor, Urology
BA, Duke; PhD, Wake Forest	
Kenneth G. Hoglund (1990)	Professor, Religion
BA, Wheaton College; MA, PhD, Duke	
Jefferson M. Holdridge (2002)	Associate Professor, English
BA, San Francisco State; MA, PhD, University College (Dublin)	
Thomas Hollis (2003)	Associate Professor, Biochemistry
BS, Florida State; PhD, University of Texas (Austin)	
Ross P. Holmes (2000)	Professor, Surgical Sciences (Urology)
BS, University of Queensland; BS, PhD, Australian National University	
Katherine Holzbour (2007)	Assistant Professor, Biomedical Engineering
ScB, Brown; MS, PhD, Stanford	
Natalie A. W. Holzwarth (1983)	Professor, Physics
BS, MIT; MS, PhD, Chicago	
David Horita (2002)	Assistant Professor, Biochemistry
BA, Carleton College; PhD, University of Wisconsin (Madison)	
Fred L. Horton Jr. (1970)	Albritton Professor of the Bible, Religion
BA, UNC-Chapel Hill; BD, Union Theological Seminary; PhD, Duke	
J. Jason Hoth (2010)	Associate Professor, Surgical Sciences (General Administration)
BS, MD, Louisiana State; PhD, Wake Forest	
Denise K. Houston (2011)	Assistant Professor, Internal Medicine
BS, MS, University of Georgia; PhD, UNC-Chapel Hill	(Gerontology & Geriatric Medicine)
Timothy David Howard (2004)	Associate Professor, Center for Genomics and Personalized Health Research
BS, MS, PhD, Wake Forest	Joint Appointment: Pediatrics
Hugh N. Howards (1998)	Professor, Mathematics
BA, Williams College; MA, CPhil, PhD, University of California (San Diego)	
Allyn C. Howlett (2007)	Professor, Physiology and Pharmacology
BS, Pennsylvania State; PhD, Rutgers	
Fang-Chi Hsu (2003)	Associate Professor, Public Health Sciences (Biostatistics)
BPH, MS, National Taiwan University; PhD, Johns Hopkins	
Michael L. Hughes (1984)	Professor, History
BA, Claremont Men's College; MA, PhD, University of California (Berkeley)	
William Gregory Hundley (2009)	Professor, Internal Medicine (Cardiology)
BS, William and Mary; MD, Medical College of Virginia	
Michael J. Hyde (1997)	University Professor of Communication Ethics, Communication
BS, Pittsburgh; MA, PhD, Purdue	
Simeon O. Ilesanmi (1993)	Professor, Religion
BA, University of Ife (Nigeria); PhD, Southern Methodist	

Ana Iltis (2010)	Associate Professor, Philosophy
BA, BAH, Villanova; MA, PhD, Rice	
Kazushi Inoue (2005)	Assistant Professor, Pathology (Tumor Biology)
MD, Gifu University School of Medicine (Japan);	
PhD, University of Tokyo Graduate School of Medicine (Japan)	
Judith Irwin (2009)	Assistant Professor, English
BA, University of Connecticut; MPhil, PhD, CUNY	
Samy S. Iskandar (1973)	Professor, Pathology (Anatomic Pathology)
MB, BCh, University of Alexandria (Egypt);	Joint Appointment: Surgical Sciences (General)
PhD, UNC-Chapel Hill	
Miriam Jacobson (2006)	Assistant Professor, English
AB, Brown; PhD, Pennsylvania	
Melissa Jenkins (2009)	Assistant Professor, English
BA, Wake Forest; MS, PhD, Harvard	
Janine M. Jennings (1998)	Associate Professor, Psychology
BSc, Toronto; PhD, McMaster (Canada)	
Mark Jensen (1993)	Adjunct Associate Professor, Religion
BA, Houston Baptist; MDiv, PhD, Southern Baptist Theological Seminary	
Miaohua Jiang (1999)	Associate Professor, Mathematics
BS, Wuhan University, China; MS, East China Normal University; PhD, Penn State	
David J. John (1982)	Professor, Computer Science
BS Emory and Henry College; MS, PhD, Emory	
A. Daniel Johnson (1998)	Lecturer, Biology
BS, UNC-Charlotte; PhD, Wake Forest	
Erik C. Johnson (2005)	Assistant Professor, Biology
BA, PhD, University of Maine	
James E. Johnson (1991)	Associate Professor, Neurobiology and Anatomy
BA, UNC-Chapel Hill; PhD, Wake Forest	
Amanda Jones (2010)	Assistant Professor, Chemistry
AB, Princeton; PhD, University of Wisconsin (Madison)	
Bradley T. Jones (1989)	Professor, Chemistry
BS, Wake Forest; PhD, Florida	
Nancy L. Jones (1988)	Adjunct Associate Professor, Pathology
BS, Virginia Poly. Inst. and SU; PhD, Wake Forest	National Institutes of Health
Paul Brandon Jones (2001)	Associate Professor, Chemistry
BS, Oklahoma State; PhD, Duke	
Sara R. Jones (2000)	Associate Professor, Physiology and Pharmacology
BS/BA, University of Georgia; PhD, UNC-Chapel Hill	Joint Appointment: Institute for Regenerative Medicine
Paul Juras (1991)	Professor, Business and Accountancy
BBA, MBA, Pace; PhD, Syracuse	
Oana Diana Jurchescu (2010)	Assistant Professor, Physics
BS, MS, University of Timisoara (Romania); PhD, University of Groningen (Netherlands)	
Claudia N. Thomas Kairoff (1986)	Professor, English
BA, Notre Dame; MA, Virginia; PhD, Brandeis	
Peter D. Kairoff (2003)	Professor, Music
BA, University of California (San Diego);	
MM, DMA, University of Southern California	

Jay R. Kaplan (1979)	Professor, Pathology (Lipid Science)
BA, Swarthmore College; MA, PhD, Northwestern	
Jeffrey A. Katula (2006)	Assistant Professor, Health & Exercise Science
BA, Augustana College; MA, Loyola University (Chicago);	Joint Appointment: Public Health Sciences
PhD, University of Illinois (Urbana-Champaign)	
Kylie Kavanagh (2008)	Assistant Professor, Pathology
BS, DVM (equivalent), Murdoch University (Australia)	(Comparative Medicine)
Master of Veterinary Science, University of Melbourne (Australia)	
Judy K. Kem (1995)	Associate Professor, Romance Languages
BA, Western Kentucky; MA, Louisville, PhD, UNC-Chapel Hill	(French)
Charles H. Kennedy (2003)	Professor, Political Science
BA, Eckerd College; AM, MPP, PhD, Duke	
Ralph Kennedy (2010)	Professor, Philosophy
BA, PhD, University of California (Berkeley)	
Lisa Kiang (2006)	Assistant Professor, Psychology
BS, Maryland; PhD, Denver	
Daniel B. Kim-Shapiro (1997)	Professor, Physics
BA, Carleton; MS, Southern Illinois; PhD, California (Berkeley)	
Nancy M. P. King	Professor, Social Sciences and Health Policy
BA, St. John's College; JD, UNC-Chapel Hill	(Public Health Sciences)
S. Bruce King (1995)	Professor, Chemistry
BS, MS, West Virginia; PhD, Cornell	
Ellen E. Kirkman (1975)	Professor, Mathematics
BA, Wooster; MA, MS, PhD, Michigan State	
Dalane Kitzman (2003)	Professor, Internal Medicine (Cardiology)
BA, MD, Johns Hopkins	
Scott W. Klein (1991)	Associate Professor, English
AB, Harvard; BA, MA, Cambridge College; MA, MPhil, PhD, Yale	
Lee Knight (2003)	Hilton Professor of Accountancy, Business and Accountancy
BS, Western Kentucky; MA, PhD, University of Alabama	
Nancy Kock (2002)	Professor, Pathology (Comparative Medicine)
BS, University of California (Irvine);	
DVM, PhD, University of California (Davis)	
L. Andrew Koman (1981)	Professor, Surgical Sciences (Orthopedics)
AB, MD, Duke	
Dilip K. Kondepudi (1987)	Thurman D. Kitchin Professor, Chemistry
BS, Madras; MS, Indian Institute of Technology; PhD, Texas	
Robert Kraft (2002)	Assistant Professor, Biomedical Engineering
BS, Rensselaer Polytechnic (Troy, NY); PhD, MIT	
Stephen I. Kramer (1996)	Professor, Psychiatry and Behavioral Medicine
BA, Pennsylvania; MD, Thomas Jefferson	
Marina Krcmar (2006)	Associate Professor, Communication
BA, Farleigh Dickinson; MA, Pennsylvania; PhD, Wisconsin (Madison)	
Steven Kridel (2002)	Associate Professor, Cancer Biology
BS, California State (Los Angeles); PhD, University of California (Irvine)	Joint Appointment: Urology
Stephen B. Kritchevsky (2007)	Professor, Internal Medicine (Gerontology & Geriatric)
BA, Chicago; MSPH, PhD, UNC-Chapel Hill	

Kathleen A. Kron (1992)	Professor, Biology
BS, MS, Michigan State; PhD, Florida	
Philip Kuberski (1989)	Professor, English
BA, MA, PhD, University of California (Irvine)	
Gregory L. Kucera (1993)	Associate Professor, Internal Medicine (Hematology/Oncology)
BS, Davidson; PhD, Wake Forest	
Raymond E. Kuhn (1968)	William L. Poteat Professor, Biology
BS, Carson-Newman; PhD, Tennessee	
George Kulik (2002)	Assistant Professor, Cancer Biology
DVM, Ukrainian Agricultural Academy, Ukraine; PhD, Institute for Experimental Pathology, Ukraine	
Timothy E. Kute (1987)	Associate Professor, Pathology (Tumor Biology)
BS, Cincinnati; PhD, Louisville	
James Kuzmanovich (1972)	Professor, Mathematics
BS, Rose Polytechnic; PhD, Wisconsin	
Abdessadek Lachgar (1991)	Professor, Chemistry
BS, MS, PhD, University of Nantes (France)	
Wei Lang (2001)	Assistant Professor, Public Health Sciences (Biostatistical Sciences)
BS, Xi'an Jiao Tong University (PR China); PhD, University of Pittsburgh	
Carl Langefeld (2000)	Assistant Professor, Public Health Sciences (Biostatistical Sciences)
BA/BS, Concordia; MS, University of Nebraska (Lincoln); MS, Florida State; PhD, University of Michigan	
Paul Laurienti (2002)	Associate Professor, Diagnostic Radiology
BS, University of Houston; MD, PhD, University of Texas	
Sang Jin Lee (2008)	Assistant Professor, Institute for Regenerative Medicine
BS, MS, Hannam University (South Korea); PhD, Hanyang University (South Korea)	
Win-chiat Lee (2010)	Associate Professor, Philosophy
BA, Cornell; PhD, Princeton	
Claudine Legault (1994)	Professor, Public Health Sciences (Biostatistical Sciences)
BS, MS, University of Quebec (Montreal); PhD, UNC-Chapel Hill	
Xiaoyan (Iris) Leng (2005)	Assistant Professor, Public Health Sciences (Biostatistics Sciences)
MS, MD, Beijing Medical University (PR China); MS, PhD, University of California (Davis)	
Bill J. Leonard (2000)	Adjunct Professor, Divinity School
BA, Texas Wesleyan; MDiv, Southwestern Baptist Theological Seminary; PhD, Boston	
Candyce Leonard (2002)	Professor, Humanities
BA, Texas Wesleyan; MEd, MA, University of Louisville; PhD, Indiana	
Jeffrey D. Lerner (1998)	Associate Professor, History
BA, MA, PhD, Wisconsin (Madison)	
Pavel J. Levy (2009)	Associate Professor, Surgical Sciences (Vascular)
MD, Hadassah University (Jerusalem)	
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MS, Shanghai Medical University (China); MD, Zhejiang University School of Medicine (China); PhD, Wake Forest	

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Kerry M. Link (1996) BS, St. John's; MD, Rochester	Professor, Diagnostic Radiology
B. Diane Lipsett BA, MA, University of Alberta (Canada); PhD, UNC (Chapel Hill)	Assistant Professor, School of Divinity
Yongmei Liu (2007) MA, Springfield College; MD, Bengbu Medical College (China); PhD, Johns Hopkins	Associate Professor, Public Health Sciences (Epidemiology and Prevention)
Mark O. Lively (1983) BS, PhD, Georgia Institute of Technology	Professor, Biochemistry
John T. Llewellyn (1990) AB, UNC-Chapel Hill; MA, Arkansas; PhD, Texas (Austin)	Associate Professor, Communication
Richard F. Loeser (2005) MD, West Virginia	Professor, Internal Medicine (Molecular Medicine)
Pat Cotton Lord (2004) BS, North Carolina State; PhD, Wake Forest	Lecturer, Biology
Allan D. Loudon (1985) BA, Montana State; MA, University of Montana; PhD, Southern California	Professor, Communication
W. Todd Lowther (2003) BA, Stetson; PhD, University of Florida	Associate Professor, Biochemistry
Baisong Lu (2009) BS, Beijing Normal University (PR China); PhD, Chinese PLA Medical Institute (PR China)	Lecturer, Institution for Regenerative Medicine
John F. Lucido (2005) BA, California State (Humboldt); MFA, UNC-Greensboro	Lecturer, Communication
Ramon Casanova Luis (2009) MA, Moscow Power Technical Institute (Moscow, Russia); PhD, Aveiro University (Portugal)	Assistant Professor, Public Health Sciences (Biostatistical Sciences)
Andrew Lustig (2010) BA, University of San Francisco; MA, Princeton; PhD, University of Virginia	Adjunct, Department of Religion Davidson College
Douglas S. Lyles (1978) BA, Pennsylvania; PhD, Mississippi	Professor, Biochemistry
David Lyons (1998) BS, Pennsylvania State; PhD, Boston	Assistant Professor, Physiology and Pharmacology
Jed Macosko (2005) BS, MIT; PhD, University of California (Berkeley)	Associate Professor, Physics and Center for Structural Biology
Michael Madigan (2006) BS, MS, Texas A&M; PhD, Virginia Commonwealth	Assistant Professor, Engineering Science and Mechanics VT/WFU School of Biomedical Engineering and Sciences
Barry G. Maine (1981) BA, Virginia; MA, PhD, UNC-Chapel Hill	Professor, English
Joseph A. Maldjian (2005) BA, Princeton; MD, UMDNJ	Professor, Diagnostic Radiology
Anthony P. Marsh (1996) BPE, MEd, University of Western Australia; PhD, Arizona State	Associate Professor, Health and Exercise Science
David F. Martin (1991) AB, Dartmouth; MD, Johns Hopkins (Orthopedic)	Professor, Surgical Sciences (Orthopedics)

Thomas J. Martin (1995) BS, UNC-Chapel Hill; PhD, Medical College of Virginia	Associate Professor, Anesthesiology
Sarah Mason (2010) BS, University of Georgia; PhD University of Pennsylvania	Assistant Professor, Mathematics
G. Eric Matthews (1979) BS, PhD, UNC-Chapel Hill	Professor, Physics
Charles E. McCall (1968) BS, MD, Wake Forest	Professor, Internal Medicine (Molecular Medicine)
Anita K. McCauley (2002) BS, Elon College; PhD, Wake Forest	Adjunct Assistant Professor, Biology
Brian A. McCool (2003) BS, University of Texas (Austin); PhD, Vanderbilt	Associate Professor, Physiology and Pharmacology
Leah P. McCoy (1990) BS, West Virginia Inst. of Tech; MA, Maryland; EdD, Virginia Poly. Inst. and State University	Professor, Education
Maria P. McGee (2010) MD, School of Medicine of Granada University (Spain)	Associate Professor, Plastic and Reconstructive Surgery
John G. McHaffie (1994) AS, Tidewater Community College; BS, Old Dominion; PhD, Virginia Commonwealth	Professor, Neurobiology and Anatomy
John McNally (2002) BA, Southern Illinois; MFA, The Iowa Writers' Workshop, University of Iowa; PhD, University of Nebraska (Lincoln)	Associate Professor, English
Linda C. McPhail (1984) BS, Methodist College; MS, PhD, Wake Forest	Professor, Biochemistry
Stephen P. Messier (1981) BS, MS, Rhode Island; PhD, Temple	Professor, Health and Exercise Science
Linda Metheny-Barlow (2006) BS, Wheeling Jesuit; MS, PhD, Rochester	Assistant Professor, Radiation Oncology (Radiation Biology)
Deborah A. Meyers (2004) BA, Ithaca College; PhD, Indiana	Professor, Center for Genomics and Personalized Medicine Research
Shannon L. Mihalko (1999) BS, Wake Forest; MS, MS, PhD, University of Illinois	Associate Professor, Health and Exercise Science
Christian Miller (2007) BA, Princeton; MA, PhD, Notre Dame	Associate Professor, Philosophy
Gary D. Miller (1996) BS, Kansas; MS, Kansas State; PhD, University of California (Davis)	Associate Professor, Health and Exercise Science
Lance Miller (2010) BS, PhD, UNC-Chapel Hill; MS, East Carolina	Associate Professor, Cancer Biology
Mark S. Miller (1996) BS, Fordham; MA, MPhil, PhD, Columbia	Professor, Cancer Biology
Michael E. Miller (1993) BA, Wooster; MS, Cincinnati; PhD, Michigan	Professor, Public Health Sciences (Biostatistics)
Timothy E. Miller (2004) BS, Mississippi State; PhD, Vanderbilt	Adjunct Assist Professor, Computer Science Parallel Computing Systems Adm in Computer Science, Physics

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Joseph O. Milner (1969) BA, Davidson; MA, PhD, UNC-Chapel Hill	Professor, Education
Akiva Mintz (2009) BA, Brooklyn College; MD, PhD, Penn State	Assistant Professor, Neurosurgery
Nilamadhab Mishra (2002) BSc, Bhadrak College (India); MD, MKCG Medical College (India)	Associate Professor, Internal Medicine (Rheumatology & Clinical Immunology)
Ananda Mitra (1994) B Tech, Indian Inst. of Technology (Kharagpur); MA, Wake Forest; PhD, Illinois (Urbana)	Professor, Communication
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Lorna G. Moore (2007) BA, Smith College; MA, PhD, University of Michigan (Ann Arbor)	Professor, Public Health Sciences
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Charles S. Morrow (1993) AB, Cornell; PhD, Saint Louis; MD, Missouri (Columbia)	Professor, Biochemistry
Michael J. Morykwas (1997) BS, University of Detroit; MS, PhD, University of Michigan	Associate Professor, Surgical Sciences (Plastic and Reconstructive Surgery)
John Charles Moskop (2009) BA, Notre Dame; PhD, University of Texas (Austin)	Professor, Internal Medicine (General)
William M. Moss (1971) BA, Davidson; PhD, UNC-Chapel Hill	Professor, English
Gloria K. Muday (1991) BS, Virginia Poly. Inst. and SU; PhD, Purdue	Professor, Biology
Michael T. Munley (2007) BSE, PhD, Duke	Associate Professor, Radiation Oncology
Michael A. Nader (1993) BS, Wayne State; PhD, Minnesota	Professor, Physiology and Pharmacology
Michelle J. Naughton (1993) BA, PhD, Iowa; MA, Michigan State; MPH, Minnesota	Professor, Public Health Sciences (Social Sciences Health Policies)
Lynn S. Neal (2006) BA, Houghton College; MTS, Duke; MA, PhD, UNC-Chapel Hill	Associate Professor, Religion
Deborah W. Newsome (2000) BA, Oklahoma Baptist; MAEd, Wake Forest; PhD, UNC-Greensboro	Associate Professor, Counseling
Maggie CY Ng (2010) BSc, PhD, Chinese University of Hong Kong (Hong Kong)	Assistant Professor, Center for Genomics and Personalized Medicine Research
Barbara Nicklas (2003) BSE, N.E. Missouri State; MS, Iowa State; PhD, University of Maryland	Professor, Internal Medicine (Gerontology)
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Patricia A. Nixon (1999) BS, Boston; MA, PhD, University of Pittsburgh	Associate Professor, Health and Exercise Science
Ronald E. Nofle (1967) BS, New Hampshire; PhD, Washington	Professor, Chemistry
James L. Norris, III (1989) BS, MS (science), MS (statistics), North Carolina State; PhD, Florida State	Professor, Mathematics
Mary Claire O'Brien (2007) BA, LaSalle College; PhD, Temple	Associate Professor, Emergency Medicine
Monique E. O'Connell (2005) BA, Brown; MA, PhD, Northwestern	Associate Professor, History
Joseph T. O'Flaherty (1982) BA, MD, Temple	Professor, Internal Medicine (Infectious Diseases)
Tadhg O'Gara (2010) BA, Notre Dame; MD, SUNY (Brooklyn)	Assistant Professor, Orthopaedic Surgery
Thomas M. D. O'Shea Jr. (1988) BA, MD, UNC-Chapel Hill	Professor, Pediatrics
Emmanuel C. Opara (2010) BSc, University of Nigeria (Nigeria); MSc, University of Surrey (England) PhD, University of London (England)	Professor, Institute for Regenerative Medicine
Ronald W. Oppenheim (1983) BA, Des Moines; PhD, Washington (St. Louis)	Professor, Neurobiology and Anatomy
David Ornelles (1993) BS, Hawaii; PhD, MIT	Associate Professor, Microbiology and Immunology
Gillian R. Overing (1979) BA, Lancaster, England; MA, PhD, SUNY (Buffalo)	Professor, English
John Owen (1993) BScM, MD, McMaster, Canada; Assoc. Fellow, Inst. of Med. Lab. Science, U.K.	Professor, Internal Medicine (Hematology/Oncology)
Timothy Pardee (2009) BS, PhD, MD, University of Buffalo	Assistant Professor, Internal Medicine (Hematology and Oncology)
Anthony S. Parent (1989) BA, Loyola; MA, PhD, University of California (Los Angeles)	Professor, History
Marian F. Parker (1999, 1999) BA, UNC-Greensboro; MSLS, UNC-Chapel Hill; JD, Wake Forest	Director of the Professional Center Library and Professor of Law
Griffith D. Parks (1993) BA, Colorado (Boulder); PhD, Wisconsin (Madison)	Professor, Microbiology and Immunology
John S. Parks (1982) BS, North Carolina State; MS, PhD, Wake Forest	Professor, Pathology (Lipid Sciences) Joint Appointment: Biochemistry
R. Jason Parsley (2010) BS, Duke; PhD, University of Pennsylvania	Assistant Professor, Mathematics
Derek Parsonage (1991) BSc, PhD, Birmingham, England	Assistant Professor, Biochemistry
Victor Paul Pauca (2003) BS, MS, Wake Forest; PhD, Duke	Associate Professor, Computer Science
Mary L.B. Pendergraft (1997) AB, PhD, UNC-Chapel Hill	Professor, Classical Languages

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Fred W. Perrino (1990) BS, Ohio State; PhD, Cincinnati	Professor, Biochemistry
Stephen P. Peters (2003) BA, Yale; PhD, MD, University of Pittsburgh	Professor, Internal Medicine (Pulmonary) Joint Appointment: Center for Genomics and Personalized Medicine
Bryon E. Petersen (2010) BS, University of Iowa; MS, PhD, University of Pittsburgh	Professor, Institute for Regenerative Medicine
John V. Petrocelli (2007) BA, Westminster College; MA, Slippery Rock; PhD Indiana (Bloomington)	Assistant Professor, Psychology
Mark J. Pettenati (1986) BS, St. Bonaventure; PhD, West Virginia (Medical Genetics)	Associate Professor, Pediatrics (Genetics)
W. Jeffrey Petty (2006) BS, Harvey Mudd; MD, UNC	Assistant Professor, Internal Medicine (Hematology/Oncology)
David P. Phillips (2003) BA, Cornell; MArch, Washington; MA, PhD, Pennsylvania	Associate Professor, Japanese (East Asian Language and Cultures)
Peter J. Pierre (2003) BS, University of Wisconsin (Oshkosh); MD, PhD, University of Memphis	Assistant Professor, Physiology and Pharmacology
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Robert J. Plemmons (1990) BS, Wake Forest; PhD, Auburn	Reynolds Professor, Mathematics
Katherine A. Poehling (2010) BA, MPH, Vanderbilt; MD, Wake Forest	Associate Professor, Pediatrics
Leslie B. Poole (1994) BA, PhD, Wake Forest	Professor, Biochemistry
Christopher Porada (2011) BA, Colgate; PhD, University of Nevada (Reno)	Associate Professor, Institute for Regenerative Medicine
Mercedes Porosnicu (2007) MD, University of Medicine (Iasi, Romania)	Assistant Professor, Internal Medicine (Hematology and Oncology)
Linda J. Porrino (1991) AB, Bates; PhD, New York	Professor, Physiology and Pharmacology
Wayne E. Pratt (2006) BA, Vermont; MS, PhD, Utah	Assistant Professor, Psychology
Sara A. Quandt (1994) BA, Lawrence; MA, PhD, Michigan State	Professor, Public Health Sciences (Epidemiology & Prevention)
Ramnarayan Ramachandran (2007) MSc, Birla Institute of Technology and Science (India); MS, Virginia Commonwealth; PhD, Johns Hopkins	Assistant Professor, Neurobiology and Anatomy
Tanisha Ramachandran (2011) BComm, BA, MA, PhD, Concordia University (Canada)	Assistant Professor, Religion
Herman Rapaport (2006) BA, California State College of Fullerton; MA, University of California (Los Angeles); PhD, University of California (Irvine)	Reynolds Professor of English

Stephen R. Rapp (1990) BA, MA, Bradley; PhD, West Virginia	Professor, Psychiatry (Geriatrics)
Sarah G. Raynor (2005) BS, Yale; PhD, MIT	Associate Professor, Mathematics
Beth A. Reboussin (1996) BS, Loyola; MS, PhD, Johns Hopkins	Professor, Public Health Sciences (Biostatistical Sciences)
David M. Reboussin (1994) BA, Pomona College; MS, Chicago; PhD, Wisconsin	Professor, Public Health Sciences (Biostatistical Sciences)
Mary Lynn B. Redmond (1989) BA, EdD, UNC-Greensboro; MEd, UNC-Chapel Hill	Professor, Education
Thomas C. Register (1991) BS, Francis Marion; PhD, South Carolina	Associate Professor, Pathology (Lipid Sciences)
Sean D. Reid (2004) BS, Bucknell; PhD, Pennsylvania State	Assistant Professor, Microbiology and Immunology
W. Jack Rejeski (1978) BS, Norwich; MA, PhD, Connecticut	Thurman D. Kitchin Professor, Health and Exercise Science
Scott Rhodes (2004) BA, College of William and Mary; MPH, University of South Carolina; PhD, University of Alabama (Birmingham)	Professor, Public Health Sciences (Social Sciences Health Policies)
Jessica A. Richard (2002) BA, Goucher; MA, PhD, Princeton	Associate Professor, English
David R. Riddle (1997) BS, UNC-Chapel Hill; PhD, University of Michigan	Associate Professor, Neurobiology and Anatomy
Michael E.C. Robbins (2002) BSc, PhD, Thames Polytechnic Woolwich, London	Professor, Radiation Biology
David C. S. Roberts (1999) BS, University of Victoria; MS, PhD, University of British Columbia	Professor, Physiology and Pharmacology
Stephen B. Robinson (1991) BA, PhD, University of California (Santa Cruz)	Professor, Mathematics
Randall G. Rogan (1990) BA, St. John Fisher College; MS, PhD, Michigan State	Professor, Communication
April Elizabeth Ronca (2004) BS, MA, PhD, Ohio State	Professor, Obstetrics and Gynecology
Luis Roniger (2006) Licenciante in Sociology, Universidad Nacional de Buenos Aires; MA, PhD, Hebrew University of Jerusalem	Reynolds Professor of Latin-American Studies, Political Science
James C. Rose (1976) BS, Richmond; MS, PhD, Medical College of Virginia	Professor, Obstetrics and Gynecology (Maternal/Fetal)
Shane D. Ross (2007) BS, PhD, California Institute of Technology; NSF, University of Southern California	Assistant Professor, VT Engineering Science and Mechanics
Jeremy Rouse (2010) BS, Harvey Mudd College; PhD, University of Wisconsin (Madison)	Assistant Professor, Mathematics
Jamin C. Rowan (2010) BA, Brigham Young, MA, PhD, Boston College	Visiting Assistant Professor, English
Lawrence L. Rudel (1973) BS, Colorado; MS, PhD, Arkansas	Professor, Pathology (Lipid Sciences)

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AB, Grinnell College; AM, Harvard; AM, PhD, Stanford	
Marissa Nichole Rylander (2007)	Assistant Professor, Biomedical Engineering
BS, MS, PhD, University of Texas (Austin);	
Akbar Salam (2003)	Associate Professor, Chemistry
BSc, PhD, University of London (England)	
Emilio Salinas (2002)	Assistant Professor, Neurobiology and Anatomy
BSc, Universidad Nacional Autonoma (Mexico); PhD, Brandeis	
Fred Salisbury (2003)	Associate Professor, Physics
BS, University of Chicago; PhD, University of California (Berkeley)	
Peter Santiago II (1987)	Professor, Biomedical Engineering
BS, MS, Virginia Poly. Inst. and SU; PhD, North Carolina State	
Cesar C. Santos (2006)	Professor, Neurology
BS, MD, Far Eastern University (Philippines)	(Child Neurology)
Justin M. Saul (2008)	Adjunct Assistant Professor, Biomedical Engineering
BS, Purdue; PhD, Case Western Reserve	
James A. Schirillo (1996)	Professor, Psychology
BA, Franklin and Marshall; PhD, Northeastern	
Elizabeth Hiltbold Schwartz (2002)	Assistant Professor, Microbiology and Immunology
BA, Auburn; PhD, Emory	
Gary G. Schwartz (1999)	Associate Professor, Cancer Biology
BA, Pamona College; PhD, State University of New York;	
MPH, PhD, UNC-Chapel Hill	
Darren F. Seals (2006)	Assistant Professor, Cancer Biology
BS, MS, PhD, Indiana-Purdue (Indianapolis)	
Michael Carlton Seeds (2006)	Assistant Professor, Internal Medicine (Molecular Medicine)
BA, MS, Virginia; PhD, Wake Forest	
Susan Sergeant (1999)	Instructor, Biochemistry
BS, Washington College; PhD, University of Missouri (Columbia)	
Catherine E. Seta (1987)	Associate Professor, Psychology
BA, MA, PhD, UNC-Greensboro	
Edward G. Shaw (2006)	Professor, Radiation Oncology
BS, Iowa; MD, Rush Medical College (Chicago)	
Gregory S. Shelness (1990)	Professor, Pathology (Lipid Sciences)
BA, PhD, New York	
Robert J. Sherertz (1990)	Professor, Internal Medicine (Infectious Diseases)
BS, Wake Forest; MD, Virginia	
Hang Shi (2009)	Assistant Professor, Internal Medicine (Gerontology)
BM, Shanghai Medical University (PR China);	
PhD, University of Tennessee (Knoxville)	
Carol A. Shively (1986)	Professor, Pathology (Lipid Sciences)
BA, Hiram; MA, PhD, University of California (Davis)	
Sally A. Shumaker (1995)	Professor, Public Health Sciences
BA, Wayne State; MA, PhD, Michigan	(Social Sciences and Health Policies)
Gale Sigal (1987)	Professor, English
BA, City College (New York); MA, Fordham;	
PhD, City University of New York	

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Wayne L. Silver (1985) BA, Pennsylvania; PhD, Florida State	Professor, Biology
Jeanne M. Simonelli (1999) BA, MA, PhD, University of Oklahoma; MPH Oklahoma Health Science Center	Professor, Anthropology
Sean Lorenzo Simpson (2009) BA, MA, Harvard; PhD, UNC (Chapel Hill)	Assistant Professor, Pubic Health Sciences (Biostatistical Sciences)
Joseph A. Skelton (2010) BS, Furman; MS, Wake Forest; MD, University of Tennessee (Memphis)	Assistant Professor, Pediatrics
Earl Smith (1998) BA, State University of New York; MA, PhD, Connecticut	Rubin Professor, Sociology
Kathleen B. Smith (2005) BA, Baldwin-Wallace; MA, PhD, Purdue	Professor, Political Science
Peter B. Smith (1976) BS, Spring Hill College; PhD, Tennessee	Professor, Biochemistry
Thomas L. Smith (1982) BS, Texas A&M; PhD, Wake Forest	Professor, Surgical Sciences (Orthopedic Surgery)
William K. Smith (1998) BS, MS, California State (San Diego); PhD, University of California (Los Angeles)	Charles H. Babcock Chair, Biology (Botany)
Beverly Mellen Snively (2000) AB, Colby College; MS, Medical College of Virginia; PhD, Johns Hopkins	Associate Professor, Public Health Sciences (Biostatistical Sciences)
Shay Soker (2004) BSc, MSc, The Hebrew University (Israel); PhD, Technion-Israel Institute of Technology (Israel)	Associate Professor, Institute for Regenerative Medicine
Cecilia H. Solano (1977) BA, Harvard; MA, PhD, Johns Hopkins	Associate Professor, Psychology
Elsayed Z. Soliman (2010) MBBCh, Cairo University (Egypt); MSc, MD, Benha University (Egypt); MS, Wake Forest	Assistant Professor, Epidemiology and Prevention
Mary Sorci-Thomas (1987) BS, Louisiana State; PhD, Wake Forest	Professor, Pathology (Lipid Sciences)
John Spangler (2004) BA, Davidson College; MD, UNC-Chapel Hill; MPH, Johns Hopkins	Professor, Family and Community Medicine
Jessica L. Sparks (2008) BS, Notre Dame; MS, PhD, Ohio State	Assistant Professor, Biomedical Engineering
Terry Stanford (1997) BA, Connecticut College; PhD, University of Connecticut	Associate Professor, Neurobiology and Anatomy
Barry E. Stein (1994) BA, MA, Queens College; PhD, City University of New York	Professor, Neurobiology and Anatomy
Lance K. Stell (2009) AB, Hope College; A.M., PhD, University of Michigan	Adjunct Professor, Translational Science Institute Davidson College
Erica Still (2008) BA, Temple; PhD, University of Iowa	Assistant Professor, English

Joel Stitzel (2004)	Professor, Biomedical Engineering
BS, PhD, Virginia Polytechnic Institute and State University; MS, Virginia Commonwealth	
Eric R. Stone (1994)	Associate Professor, Psychology
BS, Delaware; MA, PhD, Michigan	
Guangchao Sui (2006)	Assistant Professor, Cancer Biology
Bachelor, PhD, Peking University (PR China); PhD, Karolinska Institute (Sweden)	Joint Appointment: Urology
Jielin Sun (2010)	Assistant Professor, Center for Genomics and Personalized Medicine Research
BS, Nankai University (PR China); MS, Chinese Academy of Sciences (PR China); PhD, Wake Forest	
Stephen J. Susalka (2010)	Assistant Director, Office of Technology Asset Management
BS, College of William and Mary; PhD, University of Virginia	
Erin L. Sutfin (2009)	Assistant Professor, Public Health Sciences (Social Sciences and Health Policy)
BA, William Smith College; MA, PhD, University of Virginia	
Lynn Sutton (2004)	Director, Z. Smith Reynolds Library
AB, MLS, University of Michigan; PhD, Wayne State	
Andrew John Sweatt (1988)	Assistant Professor, Physiology and Pharmacology
BA, Johns Hopkins; MS, Rhode Island; PhD, Duke	
Robert L. Swofford (1993)	Professor, Chemistry
BS, Furman; PhD, California (Berkeley)	
W. Edward Swords (2002)	Associate Professor, Microbiology and Immunology
BS, Auburn; MS, Mississippi State; PhD, University of Alabama (Birmingham)	
Brian W. Tague (1995)	Associate Professor, Biology
ScB, AB, Brown; PhD, University of California (San Diego)	
E. Ann Tallant (1963)	Professor, Surgical Sciences (Hypertension & Vascular Disease Center)
BS, Memphis State; PhD, University of Tennessee	
Stephen B. Tatter (1997)	Professor, Surgical Sciences (Neurosurgery)
BS, University of Michigan; MD, PhD, Rockefeller/Cornell University Medical College	
Ryan E. Temel (2007)	Assistant Professor, Pathology (Lipid Sciences)
BS, Allegheny College; PhD, State University of New York (Stony Brook)	
Michael J. Thomas (1980)	Professor, Biochemistry
BS, Indiana University (Bloomington); PhD, University of California (Los Angeles)	
Stan J. Thomas (1983)	Associate Professor, Computer Science
BS, Davidson; PhD, Vanderbilt	
Timo Thonhauser (2008)	Assistant Professor, Physics
BS, MS, PhD, Karl-Franzens-Universität (Graz, Austria)	
Joseph R. Tobin (1994)	Professor, Pediatric Anesthesia
BA, SUNY (Buffalo); MD, SUNY (Syracuse)	
Rosemarie Tong (2009)	Adjunct Professor, Translational Science Institute UNC-Charlotte
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Janet Tooze (2005)	Assistant Professor, Public Health Sciences (Biostatistics)
AB, Earlham College; MPH, Harvard; PhD, University of Colorado	
Todd C. Torgersen (1989)	Associate Professor, Computer Science
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BA, MA, Johns Hopkins; MD, MPH, Harvard	
Suzy V. Torti (1993)	Professor, Biochemistry
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Ralph Tower Jr. (1980)	Professor, Business and Accountancy (Schools of Business)
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Alan J. Townsend (1990)	Professor, Biochemistry
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Allen Tsang (2010)	Assistant Professor, Internal Medicine (Molecular Medicine)
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William H. Turkett Jr. (2006)	Assistant Professor, Computer Science
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Christopher P. Turner (2004)	Assistant Professor, Neurobiology and Anatomy
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Olga Valbuena-Hanson (1996)	Associate Professor, English
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Mark E. Van Dyke (2005)	Assistant Professor, Institute for Regenerative Medicine
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ALA, North Idaho Junior College; BA, The College of Idaho; DrPh, MPH, Loma Linda University	
Mary Lou Voytko (1994)	Professor, Neurobiology and Anatomy
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Years following name indicate year of hire/year of appointment to current position.

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BA, MBA, Stanford	
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BA, PhD Notre Dame; MA, Duke	
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BS, Villanova	
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BA, University of Kansas;	WFU Executive Vice President for Health Affairs
MD, Loyola (Stitch School of Medicine)	
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BA, JD, Wake Forest	
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BA, Brandeis; MA, University of Southern California	
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BS, MS, Bowling Green State	
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