



**Handbook For Undergraduate
Chemistry Majors
2009-2010**

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The Chemistry Department has a long tradition of strength in undergraduate instruction. Since 2005, the Department of Chemistry has graduated 81 undergraduate students, 49 males and 32 females, with 9 minority graduates. Approximately half of these graduates go on to graduate or professional schools (20% in chemistry) with the remainder working in a wide variety of fields. Students taking the American Chemical Society standardized exam in various areas of chemistry have scored in the upper percentiles nationwide. During 2008, 34 undergraduates participated in mentored research in the chemistry department; four undergraduates were co-authors on research publications and seven were on presentations at professional meetings.

For more information email chemug@wfu.edu or see the Department of Chemistry web page at <http://www.wfu.edu/academics/chemistry> or contact Department Chair: Dr. Christa Colyer, Salem 207C, 336-758-4936, colyercl@wfu.edu.

The Chemistry Major at Wake Forest University

The department offers BA and BS degrees in chemistry, with further specialization available through the BS degree with a concentration in either Biochemistry or Materials Chemistry. All BS degrees are certified by the American Chemical Society. A chemistry minor is available also. All chemistry courses and required physics/math courses are open to chemistry majors on a letter-grade basis only. A minimum GPA of 2.0 in the first two years of chemistry is required to declare a chemistry major. Admission to any class is contingent upon satisfactory grades in prerequisite courses, and registration for advanced courses must be approved by the department. Candidates for either degree with a major in chemistry must have a minimum GPA of 2.0 in their chemistry courses numbered 200 or above.

Note: It is recommended that chemistry majors and pre-med students take more than one lab class each semester. Changes to the chemistry curriculum have made it easy for B.A. majors to study abroad in either semester of their junior year without taking more than the normal load of chemistry courses!

The department will accept transfer courses taken at four year colleges and universities that offer a major in chemistry. These courses must be equivalent in content and level to courses offered at WFU (as judged by a departmental curriculum committee). Courses taken in summer school elsewhere, or in WFU study abroad programs, must meet these same criteria and receive pre-approval. Advanced courses are typically not transferable.

Degree Requirements: The core and basic requirements (including divisionals) that are stated in the Bulletin of Wake Forest University corresponding to your year of matriculation are in effect for your graduation. However, the requirements for the major are those specified in the Bulletin corresponding to the year in which you declare your major. For 2010 majors, two options are

available: those corresponding to the 09-10 Bulletin major requirements or those that will be published in the 10-11 Bulletin. See your major adviser for more information. A list of courses available in the 09-10 Bulletin, degree requirements and typical schedules follow. But please note that variations in these schedules are possible to accommodate study abroad and other special circumstances, in which case students should talk with a member of the chemistry faculty.

***111. College Chemistry I.** (3h) Fundamental chemical principles. C—CHM 111L. (1h, D, QR)

***122. Organic Chemistry I.** (3h) Principles and reactions of organic chemistry. Students may not receive credit for both CHM 122 and CHM 123. P—CHM 111. C—CHM 122L. (1h, D)

***123. Organic Chemistry I Honors.** (3h) Principles and reactions of organic chemistry. Freshmen only, by invitation. P—CHM 111. C—CHM 123L. (1h, D)

***223. Organic Chemistry II.** (3h) Principles and reactions of organic chemistry and introductory biochemistry. P—CHM 122. C—CHM 223L (1h).

280. College Chemistry II. (3h) Advanced study of fundamental chemical principles. P—CHM 111.

280L. Theory and Methods of Quantitative Analysis Lab. (1h) Laboratory emphasizes technique development for accuracy and precision. Lab—four hours. C or P—CHM 280.

334. Chemical Analysis. (4h) Theoretical and practical applications of modern methods of chemical analysis. Lab—four hours (CHM 334L). P—CHM 341, 341L, or POI.

***341. Physical Chemistry I.** (3h) Fundamentals of thermodynamics and phenomenological kinetics, and introductory computational methods. Also listed as PHY 341. P—CHM 260, PHY 111 or 113, and 114. P or C —MTH 112. C—CHM 341L (1h). (PHY 113, with POI).

***342. Physical Chemistry IIA.** (3h) Fundamentals of quantum mechanics, statistical thermodynamics, and introductory computational methods. P—CHM 341, MTH 111-112, PHY 113-114. C—CHM 342L, (1h) (PHY 114, with POI).

***361. Inorganic Chemistry.** (3h) Principles and reactions of inorganic chemistry. P—CHM 341 or POI.. C—CHM 361L (1h).

364. Materials Chemistry. (3h) A survey of inorganic-, organic-, bio-, and nano-materials, including hybrid materials and applications. P—CHM 341 or POI.

364L. Materials Chemistry Lab. (1h) Synthesis of inorganic and organic based materials and their characterization. Lab—four hours. P or C—CHM 364.

370. Biochemistry: Macromolecules and Metabolism. (3h) Lecture course introducing the principles of biochemistry including structure, function, and biosynthesis of biological molecules, analysis of enzyme function and activity, bioenergetics, and regulation of metabolic pathways. Also listed as BIO 370. P—two of CHM 223, CHM 280, and BIO 214; or POI.

370L. Biochemistry: Macromolecules and Metabolism Lab. (1h) Laboratory emphasizes approaches for isolation and analysis of proteins and enzymes. Also listed as BIO 370L. P—two of CHM 223, CHM 280, and BIO 214; or POI. C or P—CHM 370.

373. Biochemistry: Protein and Nucleic Acid Structure and Function. (3h) 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 223 and 370 (or BIO 370).

381, 382. Chemistry Seminar and Literature. (.5h, .5h) Discussions of contemporary research and introduction to the chemical literature and acquisition of chemical information. P—CHM 122 or 123.

391, 392. Undergraduate Research. (1.5h, 1.5h) Undergraduate research. Lab—eight hours. May be repeated for credit.

* The lecture and corresponding lab are strict corequisites of each other. A student must register for both during the same semester. (However, either can be repeated independently if the student wishes.)

Typical schedule for the Bachelor of Science Degree: Requires 40.5 hours (out of 120 required for graduation). B.S. majors must engage in at least 1.5 hours of undergraduate research, an 8 hr/wk lab commitment for one semester.

First Year:	CHM 111, 111L, 122, 122L (or 123, 123L); MTH 111, 112
Sophomore:	CHM 223, 223L, 280, 280L; MTH 205; PHY 111 or 113, 114
Junior:	CHM 341, 341L, 344, 342L, 381, 382, 391 (or 392)
Senior:	CHM 334, 334L, 361, 361L, 370, 300-level elective

Typical schedule for the Bachelor of Science Degree with concentration in Biochemistry:

Requires 37.5 hours in chemistry and 1.5 hours of undergraduate research.

First Year:	BIO 112; CHM 111, 111L, 122, 122L (or 123, 123L); MTH 111, 112
Sophomore:	BIO 213, 214; CHM 223, 223L, 280, 280L; PHY 111 or 113, 114
Junior:	CHM 341, 341L, 370, 370L, 381, 382, 391 (or 392)
Senior:	CHM 334, 334L, 361, 361L, 372, 300-level elective in biology or chemistry

Typical schedule for the Bachelor of Science Degree with concentration in Materials

Chemistry: Requires a minimum of 41.5 hours in chemistry and must include the following courses:

First Year:	CHM 111, 111L, 122, 122L (or 123, 123L); MTH 111, 112
Sophomore:	CHM 223, 223L, 280, 280L; MTH 205; PHY 111 or 113, 114
Junior:	CHM 341, 341L, 342, 342L, 364, 364L, 381, 382, 391 (or 392)
Senior:	CHM 334, 334L, 361, 361L, 370, 300-level elective in physics or chemistry

Typical schedule for the Bachelor of Arts Degree: Requires at least 28.5 hours (out of 120 required for graduation). B.A. majors are encouraged to participate in undergraduate research.

First Year:	CHM 111, 111L, 122, 122L (or 123, 123L); MTH 111, 112
Sophomore:	CHM 280, 280L; one upper-level CHM elective with lab; PHY 111 or 113, 114
Junior:	CHM 341, 341L, and one upper-level CHM elective with lab
Senior:	Either CHM 381, 382, 391, or 392 and one upper-level CHM elective with lab

Typical schedule for the Bachelor of Arts Degree with a concentration in

Biochemistry/Biophysics: Requires a minimum of 31.5 hours in chemistry, 15 hours in physics, and 1.5 hours of undergraduate research as above. Total hours including all required courses: 57.5-60.5.

First Year:	CHM 111, 111L, 122, 122L (or 123, 123L); MTH 111, 112
Sophomore:	One BIO elective; CHM 223, 223L, 280, 280L; PHY 111 or 113, 114
Junior:	One BIO elective; CHM 341, 341L, 370, 370L, 391 or 392 (or substitute); PHY 215
Senior:	Two upper-level CHM electives and one PHY elective



Undergraduate students completing chemistry lab coursework.

Undergraduate Independent Research in Chemistry at Wake Forest University

One of the most important experiences for undergraduate science majors is the ability to participate in original research programs. Many of our students publish scientific papers in professional journals, give presentations at national meetings, obtain summer research internships, and win national awards based on their research. Students may receive academic credit (CHM 391 or CHM 392) or scholarships and financial incentives for research projects. Research may be conducted during the summer or the academic year. If you are interested in beginning a research project in chemistry, consult the list of chemistry faculty below. Read their research descriptions and look for areas that match your interests. Individually contact those professors whose work you find intriguing and ask for more information on available research projects.

Note that many national scholarships and awards, for both undergraduate and graduate students, are given based on past research accomplishments. For instance, WFU chemistry majors have been awarded National Science Pre-doctoral Fellowships, Rhodes Scholarships, the Barry M. Goldwater Scholarship and Glaxo-Wellcome Undergraduate Fellowships, among other accolades. The earlier in your college career you begin participating in research, the more you will learn and the stronger your application for such awards will be.



Examples of research labs where undergraduate students conduct independent research.

Chemistry Faculty Members and Their Research Interests

Dr. Rebecca Alexander (Associate Professor, Robert P. and Debra Lee Faculty Fellow)

Biochemistry: structure-function analysis of protein-nucleic acid interactions, computational analysis of macromolecular function.

Dr. Ulrich Bierbach (Associate Professor, Z. Smith Reynolds Foundation Fellow) Medicinal and Bioinorganic Chemistry: synthesis and mechanistic study of anti-cancer and anti-infectious agents, metal-DNA interactions, biocoordination chemistry.

Dr. Christa L. Colyer (Associate Professor and Department Chair)

Analytical Chemistry: capillary electrophoresis method development to facilitate bioprobe design, protein determination, and microbe detection for human and environmental health.

Dr. Lindsay R. Comstock (Assistant Professor)

Bioorganic Chemistry: synthesis of cofactor mimics and their application as tools to identify sites of biological modifications.

Dr. Patricia C. Dos Santos (Assistant Professor)

Biochemistry: essential metabolic pathways involving biological formation of metalloclusters and thio-cofactors.

Dr. Willie L. Hinze (John B. White Professor of Chemistry)

Analytical Chemistry: utilization of organized assemblies for chemical analysis and separation science.

Dr. Bradley T. Jones (Professor, Tatum Family Fellow)

Analytical Chemistry: spectrochemical analysis, instrument design and trace metal analysis.

Dr. Paul B. Jones (Associate Professor)

Organic Chemistry: photochemical methods to generate synthetically and medically significant products.

Dr. Angela G. King (Senior Lecturer)

Chemical Education: increasing student engagement with technology and peer-instruction, providing middle and high school teachers with updated content knowledge and hands-on activities.

Dr. S. Bruce King (Professor)

Organic Chemistry: synthesis of new nitric oxide/nitroxyl donors; synthesis of probes of protein redox status, organic methodology.

Dr. Dilip K. Kondepudi (Thurman D. Kitchin Professor of Chemistry)

Physical Chemistry: kinetics and thermodynamics of spontaneous generation and propagation of chiral asymmetry; theoretical study of self-propagating high-temperature synthesis of intermetallic compounds.

Dr. Abdessadek Lachgar (Professor, Bell Faculty Fellow)

Inorganic Chemistry: synthesis and characterization of porous and low-dimensional solids, and their application in catalysis, chemical separation and gas storage.

Dr. Ronald E. Nofle (Professor)

Inorganic and Materials Chemistry: synthesis, electrochemistry, spectroscopy, and structural characterization of new conducting polymers and metal-thiophene frameworks.

Dr. Al Rives (Senior Lecturer)

Chemical Education: development of instructional methods, demonstrations, and laboratory experiments to enhance student understanding.

Dr. Akbar Salam (Associate Professor, Ollen R. Nalley Faculty Fellow)

Theoretical Chemistry: long-range intermolecular forces, single- and multi-photon absorption and emission processes, and molecular chirality.

Dr. Robert L. Swofford (Professor)

Physical Chemistry: laser spectroscopy of C-H vibrational overtones and ab initio studies of anharmonic potential energies.

Dr. Mark E. Welker (William L. Poteat Professor of Chemistry and Associate Provost for Research and Faculty Affairs)

Organic Chemistry: metal mediated cycloaddition reactions and synthesis of cancer chemopreventive agents.

Research Facilities

The Department of Chemistry is fully equipped with the instrumentation and equipment required for cutting edge research. This translates into less time waiting for instrumentation and more time carrying out research. Standard instrumentation for research is available and includes a staffed high field NMR facility (Bruker Avance 300 MHz and 500 MHz NMR instruments), electron paramagnetic resonance spectrometer, GC/mass spectrometer, LC/mass spectrometer, FT-Infrared, Raman, UV-visible, Circular Dichroism, and Fluorescence spectrometers, a staffed single crystal X-ray and structure determination facility, powder X-ray diffractometer, gas and high performance liquid chromatographic systems, atomic absorption and ICP spectrometers, gel and capillary electrophoretic systems, double manifold vacuum lines, inert atmosphere glove-boxes, and electrochemical and polarographic systems. Additional instrumentation is available at the School of Medicine. Computational facilities include a 128 node Linux Beowulf cluster comprising

dual processor Intel Xeon x335 CPU's. Software includes Gaussian 03 and GAMESS electronic structure packages, extensive mathematical libraries and Fortran, C/C++ compilers. The library contains over 225 current journal subscriptions in chemistry and holds complete runs in most chemistry titles. On-line computer searching of over 200 databases is available.

Honors in Chemistry

Students who excel in both the classroom and research laboratory at Wake Forest are encouraged to pursue graduation with honors. More information is given below, but majors are encouraged to discuss possibilities with their major adviser as soon as possible.

Requirements for Graduating with Honors in Chemistry (Last updated: Feb. 02, 2010)

1. Students must have a 3.30 GPA in chemistry and a 3.00 GPA overall.
2. A written thesis must be submitted.
3. The thesis will be read by the advisor and two other faculty members. This group will constitute the student's committee and will be appointed as early as possible but no later than the beginning of the student's final semester.
4. The thesis must be presented to the department and defended. After a successful defense, the committee will sign the thesis.
5. The student will have three bound copies of the thesis made- one for the department, one for the advisor, and one for her/himself.
6. Students may carry out their honors work outside the department only if a departmental faculty member is intimately involved and serves as the student's advisor. The committee may include the outside advisor, but must include another faculty member in the Department of Chemistry.

Timetable:

- (i) Students should indicate their intention to carry out honors work with their current or potential research advisors as early as possible. They should then inform the Honors Coordinator of the tentative title of the research project, the names of committee members, and the name of the advisor. The Honors Coordinator will keep records of Honors Students and will schedule their defense times. Honors work can be started as late as two semesters before graduation but cannot be started in the last semester before graduation.
- (ii) The defense will be scheduled for the annual Honors Symposium held in the Spring. The date will be announced early each spring semester.
- (iii) The thesis must be submitted to the advisor one week before it can be presented to the full committee. The committee must then have an additional week to read the thesis before the defense. Students may not present their defense during the final exam period, or the period before commencement.

American Chemical Society Student Affiliates

The American Chemical Society is a self-governed individual membership organization consisting of 163,000 members at all degree levels and in all fields of chemistry. The organization provides a broad range of opportunities for peer interaction and career development, regardless of professional or scientific interests. The programs and activities conducted by ACS today are the products of a tradition of excellence that dates from the Society's founding in 1876.

The Student Affiliates program gives undergraduate students studying the chemical sciences the opportunity to participate in the ACS. In addition to fostering social interactions among students, the Student Affiliates program gives you the professional edge, lets you network with top professionals, and provides you with scientific meetings and direct access to research. Joining ACS entitles student affiliates to substantial discounts on ACS journals, 17 issues of *Chemical & Engineering News*, four issues of the undergraduate career magazine *in Chemistry*, career and

employment services, and the Directory of Experience Opportunities listing co-ops, internships, and summer jobs for undergraduate chemical science students. There are ACS Student Affiliates chapters at over 900 colleges and universities in the United States.

The Wake Forest University American Chemical Society Student Affiliates (WFU ACS SA) is a group of enthusiastic and motivated students who organize a wide variety of activities during the year. The chapter was awarded an Honorable Mention by the National ACS for their efforts. Students meet regularly to coordinate projects, socialize, and participate in discussions with faculty and graduate students. Because of their participation in this organization, the students are able to develop closer relationships with the chemistry faculty and with each other.

Annual activities of the WFU ACS SA include:

- Community outreach during National Chemistry Week –Events are held to provide hands-on activities for children using the theme provided by the ACS to introduce students in grades K – 5 to chemistry. In 2001, the chapter was awarded a grant by the ACS to support this project.
- Participation in Project Pumpkin – Underprivileged children are brought to the Wake Forest campus prior to Halloween for a day of fun, including a Mad Scientist Show co-sponsored by the ACS SA and the Physics Department.
- Community outreach through education – The WFU ACS SA is actively involved in outreach activities for elementary school-age children, both on our campus and in the community. Family science nights, science shows and demonstrations, and judging science fairs are some examples of these activities.

Please see the WFU ACS SA web site, <http://www.wfu.edu/academics/chemistry/acs/index.html> or contact the faculty advisor Dr. Paul Jones (jonespb@wfu.edu) for more information.

Scholarship and Award Opportunities Available to Wake Forest University Chemistry Majors

Wake Forest Research Fellowship Program The Wake Forest Research Fellowship Program is designed to encourage individual undergraduate students to collaborate with professors on scholarly research projects. Summer awards include a \$4,000 taxable stipend and free campus housing. Applicants must have a cumulative 3.0 GPA at the time of application and sophomore standing (23/25 or more hours passed) before undertaking research in this program. More information is available at http://www.wfu.edu/undergraduate_college/research-fellowship/

The Barry M. Goldwater Scholarship and Excellence in Education Program The purpose is to provide a continuing source of highly qualified individuals in the sciences or mathematics and provides funds for academic study and research. Students who plan to study medicine are eligible for a Goldwater Scholarship only if they plan a research career rather than a career as a medical doctor in a private practice. For more information see <http://www.act.org/goldwater/>

Blackbyrd Scholarship (in Chemistry) Award Presented annually to an outstanding rising junior BS chemistry major.

Churchill Scholarships Awarded to graduating seniors in engineering, mathematics, physical and natural sciences. The scholarships enable Americans to pursue graduate studies and research at Churchill College, a constituent college of Cambridge University. Wake Forest University may nominate two students per year for these highly competitive scholarships.

Environmental Studies Grants Grants of up to \$3000 from the Wake Forest Environmental Studies Program are available to support undergraduate students of ALL majors in environmental activities, including:

- Environmental work with non-profit, governmental, and industrial organizations,
- Environmental research of your own design,
- Environmental research with Wake Forest faculty or faculty at other institutions,
- Participation in programs with a significant environmental component.

John W. Nowell Award in Undergraduate Chemistry This award is given to a senior Wake Forest chemistry major each year, in recognition of a demonstrated record of ability, leadership and professional promise.

Hypercube Scholar Award in Chemistry Awarded annually to a Wake Forest University chemistry major who will enroll in a science graduate program after graduation.

American Chemical Society Undergraduate Award in Analytical Chemistry Presented to a rising senior to recognize students who display an aptitude for a career in the field.

CRC Press Freshman Chemistry Achievement Award Presented to first year students based on outstanding academic achievement in chemistry classes.

National Science Foundation Research Experiences for Undergraduates (REU) Programs

Programs consist of approximately 10 undergraduates from across the country, who work in research programs of the host institution. Each student is assigned a specific research project and works closely with the faculty advisor, and perhaps post-docs and graduate students. Students receive stipends and possibly assistance with housing and travel. For more information see listings on the bulletin board across from the stock room in Salem Hall.

Research Opportunities at the Wake Forest University School of Medicine The WFU School of Medicine offers a summer research experience where students learn basic research lab skills, techniques and technology used in biomedical research through an independent research project led by medical school faculty. Participants receive a stipend and free housing.

Adapted from Health Professions Program Home Page (<http://www.wfu.edu/~lane/hpp/>) and Wake Forest Bulletin

The information below is provided to students interested in the health careers (allopathic, osteopathic dental, podiatric and veterinary medicine, optometry, physical therapy, physician assistant, nursing medical technology and public health). The course requirements for the latter five disciplines are slightly different, and students should consult with Dr. Gary Miller, in the Health & Exercise Science Department.

The national standardized test for medicine (the MCAT) is an exam based on one year of introductory biology, one year of general chemistry, one year of organic chemistry, one year of introductory physics and one year of English. These courses must be completed, or be in the last stages of completion, by the end of your junior year typically, or before or during the semester you plan to take the MCAT exam. Biochemistry is required, or strongly recommended, by a number of allopathic medical schools and some Physician Assistant programs.

The following courses satisfy most medical school requirements and are the best suited for preparing MCAT and DAT: **All courses listed below must be taken with laboratory**

- One year of Biology with labs (at least two of the following: BIO111, BIO112, BIO213, BIO214)
- Two years of Chemistry with labs: (CHM111 (Fall, Summer), CHM122 (Spring, Summer), CHM223 (Fall, Summer), CHM280 (Spring))
- One year of Physics with labs (PHY113, PHY114)
- One semester of Math (MTH111 or MTH112)
- One semester of Biochemistry (CHM370 or BIO370)

Listed below are possible course schedules for Chemistry Degrees that satisfy MCAT and pre-med requirements. Major requirements are included, pre-med requirements are marked in bold.

Prospective B.S. Chemistry Majors			
	Fall	Spring	Summer*
Freshman	CHM111 MTH111	CHM122 MTH112	*
Sophomore	PHY 113 CHM223	PHY114 CHM280	*
Junior	BIO112 , (CHM391) CHM341, CHM381	BIO214**, (CHM392) CHM342, CHM382	*
Senior	CHM361, (CHM370 or CHM3--)	CHM334, (CHM370 or CHM3--)	*
*Summer sessions include several BIO, CHM, MTH, and PHY courses, (listed below) **BIO214 is recommended for Chemistry majors, and it is pre-requisite to CHM370. In parenthesis are included courses with optional schedule Fill in the rest of their courses with Basic and Divisional requirements			

Prospective B.S. Biochemistry Majors			
	Fall	Spring	Summer
Freshman	CHM111 MTH111	CHM122 MTH112	*
Sophomore	PHY 113 CHM223	PHY114 , BIO112 CHM280	*
Junior	BIO214 CHM341	BIO213 CHM370	*
Senior	CHM361, CHM372	CHM334, (CHM3-- or Bio3--)	*
*Summer sessions include several BIO, CHM, MTH, and PHY courses, (listed below) In parenthesis are included courses with optional schedule Fill in the rest of their courses with Basic and Divisional requirements			

Prospective B.A. Chemistry Majors			
	Fall	Spring	Summer
Freshman	CHM111 MTH111	CHM122 MTH112	*
Sophomore	PHY 113	PHY114 , (BIO112)	*

	CHM223	CHM280	
Junior	(BIO112 or BIO214) CHM341	(BIO214 or CHM370)** (CHM334 or CHM342)#	*
Senior	(CHM361, CHM372)#	(CHM370)	*

*Summer sessions include several BIO, CHM, MTH, and PHY courses, (listed below)
**BIO214 is recommended for Chemistry majors and it is a pre-requisite for CHM370
In parenthesis are included courses with optional schedule
Select one of the following lecture options (CHM334, CH361, CHM342, CHM372)
Fill in the rest of their courses with Basic and Divisional requirements

Most students complete the pre-medical requirements by the end of their Junior year. Those students that received AP credit may lighten up their work load of two science classes/semester. Others opt to take summer courses or postponed their applications one year. Note that Wake Forest routinely offers the following courses during summer sessions: CHM111, CHM122, CHM223, BIO111, BIO112, MTH111, MTH112, PHY112, PHY113. Students may also seek pre-approval to take courses at other institutions over the summer. Please contact the registrar's office for more information.

Traveling abroad for a semester should be planned ahead, because some chemistry classes have pre-requisite and they are not offered every semester. The most common time for students to travel is during the Fall Semester of their junior year.

Study Abroad for Chemistry Majors

Chemistry majors have numerous options for studying abroad. Options include a semester program before declaring the major, a semester program after declaring the major (the ideal time is spring of the junior year), a summer program, or a credit-bearing internship. Non-credit internships and research opportunities also exist. Use this advising sheet as a starting place to find the program that best meets your needs.

Why Study Abroad?

Studying abroad can help you develop new skills and talents (see page 12):

- Á Learn chemistry from a different perspective;
- Á Take a chemistry course that might not be available at Wake Forest;
- Á Enhance your critical thinking;
- Á Expand your knowledge of history, politics, economics, and society;
- Á Develop intercultural competence;
- Á Learn about yourself and have fun!

Plan Ahead

Begin planning immediately. Whether you study in a Wake Forest-administered program or in an Affiliate (non-WFU) program, you can earn academic credits that will count toward your Wake Forest degree.

Meet with your academic advisor to identify degree requirements you can fulfill while abroad. Visit the Center for International Studies to learn about the application process and scholarships and to identify resources. Visit WakeAbroad at studyabroad.wfu.edu to begin looking for programs.

Money matters

Studying abroad may be more affordable than you think. Wake Forest offers over \$400,000 in scholarships each year. WFU Study Abroad Scholarships and Global Citizens Scholarships are open to all students. Early planning will give you time to select the right program and plan how to pay for it.

Your financial aid package can be applied to eligible study abroad costs. Meet with a financial aid advisor and apply for scholarships. You can make it work!

Academic Considerations

The chemistry major requires a combination of core requirements and electives. Spring of your junior year is a good time to study abroad and take one or two chemistry courses that can count as electives in the major.

Study Abroad Program Options

Here are some of the programs approved for Chemistry majors. Meet with a study abroad advisor in the Center for International Studies and Dr. Christa Colyer in Chemistry to discuss your program selection. If you study in an Affiliate (non-WFU) program, you will need to complete a course approval process in order to transfer credits to Wake Forest.

WFU/London: Worrell **WFU/Venice: Casa Artom** **WFU/Vienna: Flow House**

Residential programs at properties owned by Wake Forest. Semester programs are up to 13.5 hours, with classes taught by a WFU professor and locally hired instructors. Summer programs are usually 3 or 4 hours, with one course taught by a WFU professor. Contact International Studies for an updated list showing who will teach in future semesters and summers.

WFU/Salamanca

Program at the University of Salamanca with courses taught in Spanish. Students should therefore have strong Spanish skills.

IFSA/Butler host university programs

IFSA/Butler assists in placing students as visiting (non-degree) students at a host university, where they take courses alongside local students. Requires a minimum GPA between 3.0 and 3.3. Options include:

Australia:

University of Adelaide (Adelaide)
University of Melbourne (Melbourne)
University of New South Wales (Sydney)
University of Queensland (Brisbane)

England:

University College London (London)

Ireland:

University College Dublin (Dublin)

New Zealand:

University of Auckland (Auckland)

Scotland:

University of St. Andrews (St. Andrews)

NYU/London

Program at NYU's center in London. Courses are taken with students from the U.S. This program includes an organic chemistry course and a lab course.

Next Steps

- Meet with your academic advisor;
- Attend a study abroad interest session;
- Meet with a Study Abroad advisor;
- Meet with WFU professors teaching in WFU programs to learn about future programs;
- Meet with a financial aid advisor.

Apply on WakeAbroad

Use the website, <http://studyabroad.wfu.edu>, to learn about programs and to apply. Affiliate programs require separate application. Apply 1-2 semesters before your chosen term abroad.