

- MS with a major in industrial chemistry
- MS with a major in molecular biology (biotechnology)
- MS with a major in environmental science

Additional information about these degrees can be found at [www.psm.unt.edu](http://www.psm.unt.edu) and [www.sciencemasters.com](http://www.sciencemasters.com).

## Courses of Instruction

All Courses of Instruction are located in one section at the back of this catalog.

## Course and Subject Guide

The “Course and Subject Guide,” found in the Courses of Instruction section of this book, serves as a table of contents and provides quick access to subject areas and prefixes.

# Department of Biological Sciences

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## Art J. Goven, Chair

*Graduate Faculty:* Allen, Atkinson, Ayre, Beitinger, Benjamin, Burggren, Chapman, Dickson, Dickstein, Dzialowski, Fitzpatrick, Fuchs, Goven, Gross, Huggett, Hughes, Hunt von Herbing, Jagadeeswaran, Johnson, Kennedy, Kunz, LaPoint, O'Donovan, Padilla, Pirtle, Roberts, Root, Schwark, Shah, Sinclair, Smith, Stevens, Tam, Thompson, Venables.

## Mission

The Department of Biological Sciences provides contemporary education of the highest quality to students pursuing graduate degrees in four degree programs: biology, biochemistry, molecular biology and environmental science. Research, strong professor-student mentoring, high-quality instruction and professional community service are the foundation of our mission.

## Research

The cornerstone of our graduate programs is the creation of new knowledge through research. We offer students the opportunity to conduct research that leads to theses and dissertations in aquatic biology, aquatic toxicology, biochemistry, cell and molecular biology, ecology, environmental science, forensic biology, genetics, limnology, microbiology, neurobiology, physiology and plant sciences. Our research is supported through numerous public- and private-sector sources.

Department resources for research and graduate training occupy more than 200,000 square feet in the Biology Building, the Science Research Building and the Environmental Education, Science and Technology Building. Greenhouses and an aquatic field station are also available for research.

## Degree Programs in Biological Sciences

The department offers graduate programs leading to the following degrees:

- Master of Arts (non-thesis or research problems in lieu of thesis), and
- Master of Science, both with a major in biology;
- Master of Science with a major in biochemistry;
- Master of Science with a major in environmental science;
- Master of Arts, and
- Master of Science, both with a major in molecular biology;
- Doctor of Philosophy with a major in biology;
- Doctor of Philosophy with a major in biochemistry;
- Doctor of Philosophy with a major in environmental science; and
- Doctor of Philosophy with a major in molecular biology, offered as part of the Federation of North Texas Area Universities.

The department offers research programs leading to the degrees listed above. Each MS requires a scholarly thesis based on original research by the student. The PhD represents attainment of the highest level of scholarship and achievement in the creation of new knowledge through independent research that culminates in a dissertation of scientific merit. The candidate is expected to have published or have accepted for publication at least one original research article in a refereed scientific journal prior to graduation.

The department offers a non-thesis option in the following degree programs: MS in biology (Teaching in the Life Sciences); MS (course work only) in environmental science; MA (course work only) in biology; MA (course work only) in molecular biology; and MA (problems in lieu of thesis) in molecular biology.

## Professional Science Master's Degree Option

The Professional Science Master's (PSM) is an innovative graduate degree option designed to allow students to pursue advanced training in science while simultaneously developing workplace skills highly valued by employers. PSM degrees prepare students for science and technology careers in business, government and nonprofit organizations. PSM degrees are MS degrees in an emerging or interdisciplinary area of science, mathematics or technology and contain a set of professional skills courses selected from such areas as business, communication, policy, law and leadership. Contrary to a traditional master's degree, a thesis is not

required but a 3 or 6 semester credit hour internship is included within the science requirement. The Department of Biological Sciences offers two PSM type degrees:

- MS with a major in molecular biology (biotechnology)
- MS with a major in environmental science

Additional information about these degrees can be found at [www.psm.unt.edu](http://www.psm.unt.edu) and [www.sciencemasters.com](http://www.sciencemasters.com).

## Application and Admission to the Programs

### Biology, Biochemistry, Molecular Biology and Environmental Science Programs

1. Application materials and information about our faculty and programs may be obtained by contacting the graduate advising secretary or coordinator of graduate programs in biology, biochemistry and molecular biology at 940-565-3627, the environmental science program at 940-565-3599, or from our web site ([www.biol.unt.edu](http://www.biol.unt.edu)). Prospective applicants meeting our admission criteria are encouraged to become familiar with the research and degree programs within the department and to seek opportunities by contacting individual faculty members or the coordinator of graduate programs in biology, biochemistry, molecular biology and environmental science.
2. Applicants must first apply and be admitted to the Toulouse School of Graduate Studies to be considered for admission to a degree program in biology, biochemistry, molecular biology or environmental science. Applicants must also submit the following directly to the department:
  - a. **departmental application form**;
  - b. **letter of intent**, including the specific program and degree sought (MA, MS or PhD); faculty member contacted as prospective professor/advisor; professional goals and objectives; the reason for choosing UNT, the Department of Biological Sciences and the specific area of interest (biology, biochemistry, molecular biology or environmental science); and
  - c. **three form letters of recommendation** from former professors if a recent graduate. One letter may be from an employer if employed for more than one year since graduation.
3. Completed applications for programs in biology, biochemistry and molecular biology meeting departmental acceptance criteria are reviewed by the faculty. Applications to the environmental science program are reviewed for acceptance by the environmental science graduate admissions committee.

Only applicants selected by a faculty member who agrees to act as the student's major professor (i.e., advisor) are eligible for admission to a graduate program in biology, biochemistry or molecular biology, and for the PhD in environmental science. Master's students in the environmental science program may select a major professor (i.e. advisor) after admission.

4. **Application deadlines:** for financial support purposes completed applications must be received in the department on or before the following dates. We encourage applications at least three months prior to anticipated enrollment.

Fall term/semester	July 1
Spring term/semester	November 1
Summer term/semester	May 1

5. **Departmental acceptance criteria.**

a. **Master's Degree (MA/MS):**

- Unconditional admission to the Robert B. Toulouse School of Graduate Studies.
- Complete application.
- A letter of intent to the department, including the specific program and degree sought (MA, MS or PhD); faculty member contacts as prospective professor/advisor; professional goals and objectives; the reason for choosing UNT, the Department of Biological Sciences and the specific area of interest (biology, biochemistry, molecular biology or environmental science).
- Three form letters of recommendation to the department, from former professors if a recent graduate. One letter may be from an employer if employed for more than one year since graduation.
- Undergraduate GPA greater than or equal to 3.0 overall or greater than or equal to 3.2 in the last 60 hours.
- Submission of GRE scores (verbal, quantitative, and analytical writing sections) is required. The program views high GRE scores as positive indicators of potential success; however, low GRE scores need not exclude a candidate who demonstrates positive indicators in other areas.
- Completion of the Graduate Preparation Course (GPC) offered by the Intensive English Language Institute may be substituted for the verbal section only of the GRE. Applicants using the GPC in lieu of the verbal section of the GRE may be required to take the GRE in order to meet requirements for other sections of the examination.
- The appropriate GRE subject test is also required for diagnostic purposes, not admission. In addition, the Medical College Admission Test (MCAT) may also be considered at the discretion of the department.

- Bachelor's degree with 24 hours, 12 of which are advanced, in a life science or appropriate related science is required for programs in biology, biochemistry and molecular biology.
- For the environmental science program, the bachelor's degree must include at least 6 credit hours of a life science (3 of which must be ecology), 8 credit hours of chemistry (must be courses with laboratories) and mathematics through calculus.
- A score on the Test of English as a Foreign Language (TOEFL) that meets or exceeds the International Admissions Office requirements for international students whose native language is not English.
- Agreement by a faculty member to serve as the applicant's major professor (i.e. advisor) is required for programs in biology, biochemistry, molecular biology and environmental science.

Provisional admission of applicants not meeting all of the criteria, except for the requirement for a major professor, may be considered at the discretion of the department. However, such students are advised to explore the Graduate School's non-degree (GNDE) program until satisfying departmental criteria. Provisionally accepted students must satisfy all admission provisions, including deficiency courses, within the time designated by the department at the time of admission or they will be dismissed from the program.

b. **Doctoral Degree (PhD):**

- Undergraduate GPA greater than or equal to 3.0 overall and greater than or equal to 3.2 in the last 60 hours.
- GPA greater than or equal to 3.4 overall for any prior graduate work.
- Complete application.
- A letter of intent to the department, including the specific program; faculty member contacts as prospective professor/advisor; professional goals and objectives; the reason for choosing UNT, the Department of Biological Sciences and the specific area of interest (biology, biochemistry, molecular biology, or environmental science).
- Three form letters of recommendation to the department, from former professors if a recent graduate. One letter may be from an employer if employed for more than one year since graduation.
- Submission of GRE scores (verbal, quantitative, and analytical writing sections) is required. The program views high GRE scores as positive indicators of potential success; however, low GRE scores need not exclude a candidate who demonstrates positive indicators in other areas.

- Completion of the Graduate Preparation Course (GPC) offered by the Intensive English Language Institute may be substituted for the verbal section only of the GRE. Applicants using the GPC in lieu of the verbal section of the GRE may be required to take the GRE in order to meet requirements for other sections of the examination.
- The appropriate GRE subject test is also required for diagnostic purposes, not admission. In addition, the Medical College Admission Test (MCAT) may also be considered at the discretion of the department.
- A score on the Test of English as a Foreign Language (TOEFL) that meets or exceeds the International Admissions Office requirements for international students whose native language is not English.
- Bachelor's degree with 24 hours in a life science or appropriate related science, 12 of which are advanced; a master's degree in a life science with a research-based thesis is desirable for programs in biology, biochemistry and molecular biology.
- For the environmental science program the bachelor's degree must be in an appropriate field related to environmental science, with course work in a life science, chemistry and mathematics. Master's program must include a thesis appropriate to environmental science.
- Agreement by a faculty member to serve as the applicant's major professor (i.e. advisor) is required for all programs.

There is no provisional admission to the PhD program.

Complete applications for programs in biology, biochemistry and molecular biology meeting departmental acceptance criteria are made available for review by the faculty of the Department of Biological Sciences. Applications to the environmental science program are reviewed by the Environmental Science Graduate Admissions Committee. Only applicants selected by a faculty member who agrees to act as the student's major professor (i.e. advisor) are eligible for admission to a graduate program in biology, biochemistry, molecular biology and environmental science.

## Degree Programs

### Biology Program

The biology program provides students the option of selecting a research track leading to the Master of Science (MS) or Doctor of Philosophy (PhD) with a major in biology, or a non-research track leading to the Master of Arts (MA) with a

major in biology. Students interested in obtaining both a master's degree and certification to teach life sciences at the secondary level may select the non-research Master of Science with a major in biology (Teaching in the Life Sciences). Students pursuing a research degree have the opportunity to conduct research leading to a thesis or dissertation in a variety of specializations, including aquatic biology, aquatic toxicology, ecology, forensic biology, genetics, immunology, limnology, microbiology, neurobiology, physiology and plant biology. Visit [www.biol.unt.edu](http://www.biol.unt.edu) for research interests of the faculty. Information on degree requirements follows the program descriptions.

### Degrees in Biology

- **Master of Science (MS) with a major in Biology** is a 30-hour research degree that requires 24 hours of formal course work, special problems and seminars at the 5000 and 6000 levels, plus a 6-hour thesis.
- **Master of Science (MS) with a major in Biology (Teaching in the Life Sciences)** is a 36-hour non-thesis degree for students who have a BA or BS in a life science and wish initial teacher certification for teaching the life sciences at the secondary level. The degree requires 18 hours in biology (BIOL 5260, 5830 and 6150, plus 9 elective graduate hours in biology) and 18 hours in secondary education (EDSE 5002, 5004, 5005, 5105, 5115 and 5470). Admission to secondary education courses requires the student to meet all College of Education requirements. Students completing this non-thesis MS are not eligible for the PhD program in the Department of Biological Sciences.
- **Master of Arts (MA) with a major in Biology** is a 36-hour non-thesis degree with formal course work at the 5000 and 6000 levels. Students completing the non-thesis MA at UNT are not eligible for the PhD program in the Department of Biological Sciences. The MA has a foreign language requirement.
- **Doctor of Philosophy (PhD) with a major in Biology** is a scholarly research program of 90 hours at the 5000 and 6000 levels beyond the bachelor's degree or 60 hours beyond the master's degree, including a 12-hour dissertation.

### Biochemistry Program

*Research Faculty:* Allen, Ayre, Benjamin, Chapman, Dickstein, Hughes, Jagadeeswaran, Kunz, O'Donovan, Padilla, Pirtle, Root, Shah, Smith.

Faculty research interests in biochemistry reflect the broad nature of this discipline, including microbial and plant metabolism, regulation of prokaryotic and eukaryotic gene expression and protein-protein

interactions. A specially tailored degree plan will be determined in consultation with the student's major advisor and graduate committee members. Research laboratories are equipped with state-of-the-art instrumentation, and several courses focus on contemporary technical approaches in biochemistry and molecular biology. Specialized instrumentation assists in the analyses of protein/nucleic acid structure and function, molecular imaging, metabolite identification, functional genomics and gene discovery. Visit [www.biol.unt.edu](http://www.biol.unt.edu) for more information on the research interests of the biochemistry program faculty. Information on degree requirements follows the program descriptions.

### Degrees in Biochemistry

- **Master of Science (MS) with a major in Biochemistry** is a 30-hour research degree that requires 24 hours of formal course work including a minimum of three biochemistry core courses\* (with a minimum grade of B) beyond BIOC 5540 and 5550, special problems, and seminars at the 5000 and 6000 levels, plus a 6-hour thesis. Supporting elective courses may be in biology, chemistry, computer science, mathematics or physics.
- **Doctor of Philosophy (PhD) with a major in Biochemistry** is a research program of 90 hours at the 5000 and 6000 levels beyond the bachelor's degree or 60 hours beyond the master's degree, including a 12-hour dissertation. A minimum of four biochemistry core courses\* beyond BIOC 5540 and 5550 with a minimum grade of B are required. Supporting elective courses may be in biology, chemistry, computer science, mathematics or physics.

\**Biochemistry Graduate Core Courses: BIOC 5540 and 5550, or the equivalents, are prerequisites for the core courses. Three of the following are required for the MS and four for the PhD: BIOC 5340 or 6600 (only one may count as a core course), 6610, 6620, 6630, 6640 and 6650. In exceptional cases the substitution of a comparable course may be made for one core course.*

### Molecular Biology Program

The molecular biology program leading to the PhD degree is offered through the Federation of North Texas Area Universities to students enrolled at UNT or Texas Woman's University (TWU). Students enrolled through either UNT or TWU have the opportunity to take courses, participate in seminars and conferences, and conduct research at both universities. Research opportunities at UNT include pyrimidine metabolism in bacteria; *Pseudomonas* ATCase; mechanisms of natural transformation in Gram-negative bacteria; organization and evolution of *Pseudomonas* catabolic plasmids; role of

5-hydroxytryptamine in the regulation of glycogenolysis; cyanide biodegradation; chemistry and enzymology of pathways for catabolism of aromatic compounds in soil microorganisms; brain-stem lipids; mammalian and plant gene structure, organization and expression; and regulations of blood cell differentiation. Research opportunities at TWU include binding and transport in cell membranes, gene regulation and hormone action, glycoprotein synthesis and secretion, functions of estrogen compounds in plants, biology of retro-viruses, bacterial conjugation and gene transfer, aspects of brain development and brain function, and mechanisms of generating motor patterns. Visit the web site at [www.biol.unt.edu](http://www.biol.unt.edu) for research interests of the UNT faculty. Visit [www.twu.edu/as/bio](http://www.twu.edu/as/bio) for the research interests of the TWU faculty. Applications are considered for the molecular biology program only after meeting the admission requirements either of the Robert B. Toulouse School of Graduate Studies and the Department of Biological Sciences at UNT or the Graduate School and Department of Biology at TWU. Information on degree requirements at UNT follows the program descriptions.

### Degrees in Molecular Biology

- **Master of Arts (MA) with a major in Molecular Biology** is a non-thesis degree offered through UNT that requires 36 hours with two options: (1) 30 hours of organized course work at the 5000 and 6000 levels and a 6-hour problems in lieu of thesis; or (2) 36 hours of formal course work at the 5000 and 6000 levels. Students completing the non-thesis MA at UNT are not eligible for the PhD program in the Department of Biological Sciences. The MA degree has a foreign language requirement.
- **Master of Science (MS) with a major in Molecular Biology, Option I** is a 30-hour research degree offered through UNT that requires 24 hours of formal course work, special problems, and seminars at the 5000 and 6000 levels, plus a 6-hour thesis.
- **Master of Science (MS) with a major in Molecular Biology, Option II** is a non-thesis degree that prepares students interested in biotechnology for careers in industry and government. This degree is recognized as a Professional Science Master's degree and requires 36 semester credit hours of organized course work at the 5000 and 6000 levels, including a 4-hour internship. Candidates are required to complete a curriculum composed of 14 hours in core biology/biochemistry/molecular biology related courses and 6 hours of elective science courses in the same disciplines, and an additional 12 hours of non-science professional development or "plus" courses selected from a list of courses in business, public administration,

communication, philosophy, economics and writing. The course of study is selected with the guidance of a graduate advisory committee. Satisfactory completion of a written comprehensive exit exam is required of all candidates.

- **Doctor of Philosophy (PhD) with a major in Molecular Biology** is a scholarly research program, offered through the Federation of North Texas Area Universities, of 90 hours at the 5000 and 6000 levels beyond the bachelor's degree or 60 hours beyond the master's degree, including a 12-hour dissertation.

### Environmental Science Program

*Research Faculty:* Atkinson, Beitinger, Dickson, Huggett, Johnson, Kennedy, LaPoint, Roberts, Stevens, Thompson, Venables.

The environmental science program is an interdisciplinary collaboration among the Department of Biological Sciences, the Department of Geography, the Department of Chemistry, the Department of Philosophy and Religion Studies and other departments at UNT. The program offers graduate studies in environmental science that lead to the MS and PhD, granted through the Department of Biological Sciences. The course of study, involving both core and elective courses, is designed to accommodate students with various backgrounds and interests in the natural, physical and social sciences who desire careers related to environmental science. Students are trained to identify problems, collect and interpret data, and develop solutions to complex and challenging environmental problems facing municipalities, industries, utilities and government agencies.

Visit [www.biol.unt.edu](http://www.biol.unt.edu) or [www.ias.unt.edu](http://www.ias.unt.edu) for more information on the diverse research interests of the environmental science program faculty, including aquatic biology, analytical chemistry, aquatic and terrestrial toxicology, ecology, ecophysiology, limnology, remote sensing and land use analysis, and environmental modeling. Information on degree requirements follows the program descriptions.

### Degrees in Environmental Science

- **Master of Science (MS) with a major in Environmental Science, Option I** is a 36-hour scholarly research degree that requires 30 hours of organized course work, special problems, and seminars at the 5000 and 6000 levels, plus a 6-hour thesis.
- **Master of Science (MS) with a major in Environmental Science, Option II** is a non-thesis degree that prepares students interested in environmental science for careers in industry and government. This degree is recognized as a Professional Science Master's degree and requires 36 semester credit

hours (SCH) of organized course work at the 5000 and 6000 levels, including a 4-hour internship. Candidates are required to complete a curriculum composed of 10 SCH in core environmental science related courses and 12 SCH of elective environmental science courses, and an additional 12 SCH of non-science professional development or "plus" courses selected from a list of courses in business, public administration, communication, philosophy, economics and writing. The course of study is selected with the guidance of a graduate advisory committee. Satisfactory completion of a written comprehensive exit exam is required of all students.

- **Doctor of Philosophy (PhD) with a major in Environmental Science** is a scholarly research program of 90 hours at the 5000 and 6000 levels beyond the bachelor's degree or 60 hours beyond the master's degree, including a 12-hour dissertation. The degree plan includes 41 to 45 semester hours of core requirements (depending on which optional core courses are selected) and 12 hours of dissertation. The remaining hours are selected from a list of electives, the number of hours depending on whether the student is in the 60-hour or 90-hour program.

## Degree Requirements and Procedures

### Biology, Biochemistry, Molecular Biology and Environmental Science Programs Master's Degree

1. The program and specific degree is determined before admission.
2. During the **first** long term/semester, the student and major professor select an advisory committee of two other faculty members, one of whom must be from the departmental faculty. The third may be from another UNT department, the Federation of North Texas Area Universities, or another university if the member is granted adjunct status in the department. Additional members may be added to the committee as long as the majority of the committee are faculty in the Department of Biological Sciences. A copy of the form designating the committee should be filed with the graduate advising secretary before the student's second long term/semester. Students in the MS with a major in biology (Teaching in the Life Sciences) are advised by the Teaching in the Life Sciences Program Selection Committee.
3. Before registering for the **second** long term/semester, the student, major professor and advisory committee formulate a degree plan of the courses to be taken by the student, including core course

requirements and deficiency work. Research MS students in biology, biochemistry and molecular biology must take a minimum of 24 hours of formal courses, special problems and seminars, plus 6 hours of thesis.

Students in the MS with a major in biology (Teaching in the Life Sciences) must take 18 hours of biology courses, including BIOL 5260, 5830 and 6150, plus 18 hours in secondary education (EDSE 5002, 5004, 5005, 5105, 5115 and 5470).

Students in the biology program's MA course work-only option must take a minimum of 36 hours of formal 5000-6000 level courses. Students in the biology program's MA problems in lieu of thesis option must take 30 hours of formal courses plus 6 hours of problems in lieu of thesis. The MA has a language requirement.

Research MS students in environmental science must take a minimum of 30 hours of formal courses, special problems and seminars, plus 6 hours of thesis.

Students in the environmental science MS non-thesis option must take a minimum of 42 hours of formal 5000- to 6000-level courses. Only 6 hours of special problems (5900/5910) may be applied to the research MS degree program.

The degree plan, signed by all committee members, should be filed with the graduate advising secretary for programs in biology, biochemistry and molecular biology, or with the environmental science program's graduate advising secretary, before the beginning of the student's second long term/semester. The degree plan must be approved by the chair of the Department of Biological Sciences before it is forwarded to the Robert B. Toulouse School of Graduate Studies.

All course work must be at the 5000 and 6000 levels. Students pursuing the MA or MS may not receive graduate credit for any course below the 4000 level by taking the course under a 5000-level designation, such as special problems. Undergraduate courses, except those cross listed as graduate courses, are considered to be deficiencies and are not included in the graduate degree plan hours.

4. Before registering for the **third** long term/semester, students on a thesis or problems in lieu of thesis track should submit a formal research proposal to the major professor and advisory committee for approval. Students may not register for thesis (5950) or problems in lieu of thesis (5920/5930) until an approved research proposal is filed with the graduate advising secretary.

5. After the approved research proposal is filed, the student may register for thesis or problems in lieu of thesis hours. Once registered for thesis, but not problems in lieu of thesis, **the student must maintain continuous enrollment in at least 3 hours of**

**5950 during each long term/semester until the thesis is submitted to the graduate school.** Failure to maintain continuous enrollment may invalidate previous thesis credit or result in the student being dismissed from the degree program, unless granted an official leave of absence by the dean of the Robert B. Toulouse School of Graduate Studies. If the student uses university facilities or faculty time or both during one or more summer terms/semesters, the student must also enroll for a minimum of 3 hours of 5950 during the summer.

6. Following approval by the major professor, a draft of the completed thesis or problems in lieu of thesis must be submitted to the committee at least two weeks prior to its defense and final examination.

7. A formal public seminar based on the thesis must be presented by the student to the department (students pursuing a problems in lieu of thesis present only to their committee) during the student's final term/semester. The student must schedule a room for and publicly advertise the seminar and defense through the graduate advising secretary for biology, biochemistry and molecular biology, or environmental science.

8. Directly following the seminar, the student defends the thesis in a final oral examination conducted by the major professor and advisory committee.

9. Students in the MA 36-hour biology course work option and the environmental science MS non-thesis option must take a final comprehensive oral examination given by the advisor/major professor and advisory committee during the final term/semester. Students in the MA problems in lieu of thesis option must take their final examination during presentation of the problems in lieu of thesis to the faculty advisor/major professor and advisory committee in the final term/semester. Students in the MS with a major in biology (Teaching in the Life Sciences) must take a final oral comprehensive examination given by the Teaching in the Life Sciences Advisory Committee during the final term/semester.

10. The student is responsible for completing all requirements and meeting all deadlines for graduation within the time specified by the graduate school.

11. A final copy of the student's thesis or problems in lieu of thesis must be submitted to the Department of Biological Sciences main office, either bound or on disk in .pdf format.

### Doctoral Degree

1. During the **second** long term/semester, the student and major professor select an advisory committee of four other faculty members, three of whom must be from the department faculty. The fourth

may be from another UNT department, the Federation of North Texas Area Universities or another university if the member is granted adjunct status in the department. Additional members may be added to the committee as long as the majority of the committee are faculty in the Department of Biological Sciences. A copy of the form designating the committee should be filed with the graduate advising secretary before the student's third long term/semester.

2. Before registering for the **third** long term/semester, the student, major professor and advisory committee prepare a formal degree plan of the courses to be taken by the student, including the language or tool- subject requirement. The degree plan consists of 60 hours for students with an approved master's degree, or 90 hours for students having only a bachelor's degree, including 12 hours of dissertation. Only 6 hours of special problems (6900-6910) may be counted toward the degree. The number of individual research (6940) hours counted toward the degree is determined by the advisor and advisory committee. A copy of the degree plan, signed by all committee members, should be submitted to the graduate advising secretary before the student's **third** long term/semester. All course work must be at the 5000 and 6000 levels. Doctoral students may not receive graduate credit for any undergraduate course by taking the course under a 5000- or 6000-level designation, such as special problems. Undergraduate courses, except those cross listed as graduate courses, are considered to be deficiencies and are not included in the graduate degree plan hours.

3. Students must satisfy the university language requirement or, in lieu of a foreign language, students may complete 6 hours of acceptable tool-subject courses specified by the major professor and the advisory committee. Exceptions to this requirement may be made for students whose native language is not English.

4. Before registering for the **fifth** long term/semester, a formal research proposal should be submitted to the major professor and advisory committee for approval. Students may not register for dissertation hours (6950) until a research proposal is filed with the graduate advising secretary for programs in biology, biochemistry, molecular biology and environmental science.

5. Only following submission and approval of the research proposal may the student begin registering for dissertation hours. Once registered for dissertation, **the student must maintain continuous enrollment in at least 3 hours of 6950 during each long term/semester until the dissertation is submitted to the graduate school.** Failure to maintain

continuous enrollment may invalidate previous 6950 credit or result in the student being dismissed from the degree program, unless granted an official leave of absence by the dean of the Robert B. Toulouse School of Graduate Studies. If the student uses university facilities or faculty time or both during one or both summer terms/semesters, the student must also enroll for a minimum of 3 hours of 6950 during the summer.

6. Doctoral students may take written and oral candidacy examinations only after completion of all of their degree plan course requirements. Oral examinations may be taken only after the student has passed all written examinations. **Both examinations must be completed at least nine months prior to graduation.** The manner and form of the written and oral candidacy examinations are determined by the major professor, who is chair of the student's advisory committee, and the committee members. The student must schedule a room for the examinations through the graduate advising secretary for biology, biochemistry, molecular biology or environmental science. The committee members should send all written examinations to the graduate advising secretary at least one day prior to the scheduled date of the examination. The examining professor sets guidelines for administration of written examinations.

7. Following approval by the major professor, a draft of the dissertation must be submitted to the committee at least two weeks prior to the defense of the dissertation and final examination.

8. A formal seminar based on the dissertation must be presented by the student during the student's final term/semester. The candidate must schedule a room for and publicly advertise the seminar and defense through the graduate advising secretary for biology, biochemistry, molecular biology or environmental science.

9. Directly following the seminar, the candidate defends the dissertation in a final oral examination conducted by the major professor and advisory committee.

10. The candidate is responsible for completing all requirements and meeting all deadlines for graduation within the time specified by the graduate school.

11. A final copy of the dissertation must be submitted to the Department of Biological Sciences main office either bound or on disk in .pdf format.

## Institute of Applied Sciences

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Building, Room 215

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Web site: [www.ias.unt.edu](http://www.ias.unt.edu)  
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### Samuel Atkinson, Director

The Institute of Applied Sciences (IAS) provides research and educational programs that address the natural and human resource issues facing Texas, the nation and the world. With an emphasis on water, land, people and communities, IAS seeks to explore resources for the future. The strength of IAS is its interdisciplinary approach to instruction, research and community service. The Institute is presently organized into four program areas: water resources, environmental chemistry, remote sensing and land use analysis, and archaeology. The institute provides educational programs for students seeking training in environmental studies and other applied science areas. It also offers continuing education programs such as workshops, mini-courses, seminars and symposia to the public.

Activities include basic and applied studies in a variety of fields, including the analysis of trace organic and inorganic compounds in air, water, soils, waste materials and biological samples; toxicology; land use analysis via remote sensing and Geographic Information Systems (GIS); archaeological reconnaissance and salvage; and water resources management. The institute is particularly active in the coordination and execution of joint research projects with industry and governmental agencies in these areas. The following centers support this role.

### Aquatic Toxicology and Reservoir Limnology

As one of the foremost aquatic toxicology laboratories in the Southwest, the lab is equipped to conduct acute and chronic toxicity tests with freshwater and marine organisms for industries and municipalities on the effects of chemicals on aquatic ecosystems. The reservoir limnology program conducts water quality research on rivers and reservoirs throughout Texas.

### Center for Remote Sensing

The Center for Remote Sensing (CRS) applies remote sensing technologies and Geographic Information Systems (GIS) to land use and water resources issues. The center's state-of-the-art computer facilities for remote sensing data collection, image enhancement, classification and analyses

support a variety of basic and applied research. The primary thrust of the research is to understand interrelationships between local or regional land use patterns and water quality. The center has a fully equipped Earth Resources Data Analysis System (ERDAS) and ARC/INFO capabilities.

### Center for Watershed and Reservoir Assessment and Management

Surface reservoirs in Texas currently provide 55 percent of drinking water for Texas citizens and serve as significant sources of water for agriculture, industry and recreation. However, maintaining these services is becoming increasingly more difficult and complex. The center offers scientific knowledge and expertise to address the current and emerging watershed scale issues of Texas. The center's expertise is based on more than 60 years of problem-solving research and state-of-the-art capabilities.

### Ecological Risk Assessment/Water Research Field Station

UNT has two of the few facilities in the U.S. designed to assess, under field conditions, the effects of new chemicals and pesticides on aquatic ecosystems prior to their use in the general environment. The Water Research Field Station (WRFS) consists of 48 aquatic testing ponds of 0.1 acre each and 52 1,000- and 10,000-liter microcosms. The Artificial Stream Facility has 12 replicate five-meter streams, each capable of being colonized by aquatic species. The WRFS is specifically designed to assess the impacts of agrichemicals on aquatic populations and communities. The field station and stream facility are supported on campus by a biological and residue analysis laboratory with state-of-the-art equipment.

### Environmental Chemistry

The Environmental Chemistry Laboratory supports research on the physical and chemical processes that control the fate and effect of chemicals in soil, surface water, ground water and the atmosphere using state-of-the-art equipment to analyze metals and organic chemicals in water and soils.

### Environmental Archaeology and Geology

The institute's faculty are experienced in the design and implementation of cultural resource management projects. The emphasis is on reconstruction of past environments and cultural ecology as part of archaeological research. Quaternary geologic studies are supported by a sediment-soils laboratory that has full capabilities for mechanical, chemical and mineralogical analyses of samples from archaeological sites and natural deposits. A comparative osteology lab maintains an extensive collection of animal skeletons for zooarchaeological research and forensic analysis. An off-campus

lab includes facilities for artifact washing and cataloging, detailed analysis and artifact curation. Environmental geology, groundwater hydrology, geomorphology, soil science, sedimentology and hydrology research are also conducted.

### Environmental Modeling

This laboratory develops and uses mathematical models and computer simulations for the assessment of risks and impacts of anthropogenic stressors on ecological systems. Research is conducted at local, landscape, regional and global scales. The main themes of the laboratory involve linking of environmental models to remote sensing, GIS and other advanced technology in order to understand landscape and regional dynamics; reveal global change effects on ecosystems; and to relate environmental policies to environmental issues and economic development.

### Center for Network Neuroscience

Main Office

Science Research Building, Room 120

Mailing address:

1155 Union Circle #305220

Denton, TX 76203-5017

940-565-3615

E-mail: gwgross@cnnns.org

#### Guenter W. Gross, Director

Students interested in neurobiology, electrophysiology, neuropharmacology, neurochemistry or biophysics can participate in transdisciplinary investigations directed at the self-organization of small nerve cell networks and their ability to generate and process spatio-temporal patterns. Direct applications of network dynamics to the fields of pharmacology, toxicology, drug development, tissue-based biosensors and modeling of complex systems have been demonstrated and represent ongoing research efforts.

The center uses *in vitro* preparations with primary focus on monolayer cultures of mammalian central nervous system cells growing on high density microelectrode arrays. Parallel recording with 64 or 256 amplifier systems allows long-term monitoring of network action potential production used for quantification of network responses to chemical and pharmacological compounds or to electrical stimulation. Sophisticated multichannel data processing programs support such analyses. In order to achieve high throughput, an 8-network 256-electrode platform, coupled to a liquid handling robot, is being tested for reproducibility and applications to rapid toxicity screening. The CNNNS pioneered much of the microelectrode array technology and has extensive international contacts.

### Laboratory of Forensic Anthropology and Human Identification

Biology Building, Rooms 403-405

Mailing address:

1155 Union Circle #305220

Denton, TX 76203-5017

E-mail: harrell@unt.edu

#### Harrell Gill-King, Director

The Laboratory of Forensic Anthropology and Human Identification is a component of the UNT System's Center for Human Identification housed at the UNT Denton campus and the UNT Health Science Center at Fort Worth. The laboratory provides human remains location and recovery assistance to law enforcement and medicolegal professionals across the U.S. and postmortem laboratory analysis. The laboratory participates in the Combined DNA Index System (CODIS) by entering samples from unknown human remains. The laboratory provides graduate academic training and accredited professional training to law enforcement and medicolegal investigators and to a number of federal agencies. The main laboratories (osteology lab, decomposition lab and x-ray facility) are housed in the Department of Biological Sciences, as are the J.R. Lott Osteology Reference Collection and teaching labs. Cooperating entities include the Zooarchaeology Laboratory located in the Department of Geography, the Center for Remote Sensing located in the environmental science program and the electron microscopy facility located in the Center for Advanced Research and Technology at Discovery Park. Ongoing research activities include remote digital image analysis of clandestine burials, thermobaric effects on human bone, skeletal endocrinology and pathology related to drug use, isotopic analysis of human diet, taphonomy, and techniques in human identification.

### Financial Support

Most biological sciences graduate students are supported through teaching assistantships (TAs) and research assistantships (RAs) funded through research grants to faculty. Assistantships are limited to 20 hours per week, which is considered as half-time employment. Nine-month stipends range from \$13,000 for entering master's students and up to \$19,000 for PhD candidates. In addition, out-of-state and international students who are supported at least one-half time are eligible for in-state tuition. Students supported for nine months on TAs or RAs are eligible for 12-month health insurance coverage. A limited number of summer TAs are available. Contact the Administrative Services Officer at 940-565-3600 for further information

about assistantships. Contact Student Financial Aid and Scholarships at 940-565-2302 for student loan information.

## Courses of Instruction

All Courses of Instruction are located in one section at the back of this catalog.

## Course and Subject Guide

The "Course and Subject Guide," found in the Courses of Instruction section of this book, serves as a table of contents and provides quick access to subject areas and prefixes.

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# Department of Chemistry

Main Departmental Office  
Chemistry Building, Room 101

Mailing address:  
1155 Union Circle #305070  
Denton, TX 76203-5017  
940-565-2713

Web site: [www.chem.unt.edu](http://www.chem.unt.edu)  
E-mail: [chem@unt.edu](mailto:chem@unt.edu)

## William Acree, Chair

*Graduate Faculty:* Acree, Borden, Chyan, Cooke, Cundari, Golden, Kelber, J. Marshall, P. Marshall, Mason, Omary, Petros, Richmond, Schwartz, Theriot, Thomas, Verbeck, Wilson, Youngblood.

Student stipends, including teaching assistantships and research fellowships, are available from a variety of sources. Stipends may range up to \$25,000 per year depending upon demonstrated academic and research competence. Further information may be obtained from the chair of the Graduate Affairs Committee.

## Research

A variety of research programs are in progress involving analytical, computational, inorganic, organic and physical chemistry, as well as chemistry education. Specific areas of study include synthesis, properties and kinetic investigations of transition metal carbonyls; syntheses and properties of nitrogen heterocycles; NMR applications to organometallic chemistry; gas phase kinetics; spectroelectrochemistry; morphology of inorganic precipitates; thermodynamics; Raman scattering; materials analysis and development; properties of surface adsorbed molecules; crystallography; polymer liquid crystals; interfacial processes; organosilicon synthesis and kinetics; polycyclic cage compounds; ferroelectric thin films; basis set development; computer-aided catalyst design; computational organic chemistry; chemical vapor deposition; and reactivities of metal and oxide surfaces.

The department possesses more than \$6.3 million of capital equipment, including 200 MHz, 300 MHz and 500 MHz multinuclear FT-NMR with CP/MAS solids capability, Auger/ESCA, FT-IR, Raman, mass spectrometers, HPLC GCs, GCMSs, Powder XRD, single crystal XRD, AA, uv-vis, electrochemical analyzers stopped-flow kinetic analyzer, pulsed-laser flash photolysis, laser-induced fluorescence