Hanks, Richard W. (1963) BES, Yale U., 1957; PhD, U. of Utah, 1960.
Hedman, Paul O. (1977) BS, U. of Utah, 1957; PhD, Brigham Young U., 1973.
Pope, Bill J. (1958) BS, U. of Utah, 1947; MS, PhD, U. of Washington, 1948, 1959.
Smoot, L. Douglas (1967) BS, BES, Brigham Young U., 1957, 1957; MS, PhD, U. of Washington, 1958, 1960.

Chemistry and Biochemistry

Paul B. Farnsworth, Chair
C-104 BNSN, (801) 422-6502

College of Physical and Mathematical Sciences Advisement Center
N-179 ESC, (801) 422-6270

Admission to Degree Program

All degree programs in the Department of Chemistry and Biochemistry are open enrollment. However, special limitations apply for teaching majors.

The Discipline

Chemistry is the study of matter, the changes undergone by matter, and the laws that govern the changes. Chemists study atoms as well as the structures and reactions of molecules. They also work to develop simplifying models (theories) that permit the correlation and explanation of observations about matter. Chemical principles are fundamental to the understanding of subjects ranging from the molecular basis of biology to the structure of rocks and minerals. Chemistry is an essential foundation in engineering disciplines, especially in chemical engineering, electronics, energy and environmental science, geology, pharmacy and medicine, and in virtually all manufacturing areas.

Chemistry is an active science that is vital to human existence. Energy needs, environmental concerns, and requirements for new materials all involve major contributions from chemists. Examples of the diverse areas of interest to chemists include regulation of protein synthesis, signal transduction at the cellular level and proteomics (biochemistry), design and synthesis of medicinal compounds (organic chemistry), design and synthesis of new molecular structures and materials (inorganic chemistry), spectroscopic study of energy transfer and molecular structures (physical chemistry), and analysis of medicinal compounds, biological materials, and contaminants or trace elements found in the environment (analytical chemistry).

Chemistry involves more than test tubes and beakers. It includes working with a variety of equipment and instruments such as mass spectrometers, calorimeters, chromatographs, ultracentrifuges, lasers, X-ray diffractometers, and nuclear magnetic resonance spectrometers.

Career Opportunities

Graduates in chemistry obtain positions in virtually every industry, and those who have imagination and intellectual curiosity are in particular demand. Chemistry is also an excellent preprofessional course of study for those interested in medicine, dentistry, law, and business. The chemistry curriculum is both rigorous and intellectually rewarding.

Graduation Requirements

To receive a BYU bachelor's degree a student must complete, in addition to all requirements for a specific major, the following university requirements:

- The university core, consisting of requirements in general and religious education (See the University Core section of this catalog for details. For a complete listing of courses that meet university core requirements, see the current class schedule.)
- A minimum of 30 credit hours in residence
- A minimum of 120 credit hours
- A cumulative GPA of at least 2.0

Undergraduate Programs and Degrees

BA	Chemistry
BS	Biochemistry
BS	Chemistry
BS	Chemistry Education
Minors	Chemistry
	Chemistry Education

Students should see the department office for help or information concerning the undergraduate programs.

Graduate Programs and Degrees

MS	Chemistry
MS	Biochemistry
PhD	Chemistry
PhD	Biochemistry

For more information see the BYU 2007–2008 Graduate Catalog.

General Information

Required High School Preparation

1. It is recommended that a student complete the following courses in high school:

   3 units of English
   2 units of physical science, chemistry, and physics.
   4 units of mathematics, consisting of 2.5 units of algebra, 1 unit of geometry, and 0.5 unit of trigonometry. This should qualify students to begin college mathematics with Math 112, analytic geometry and calculus.

   Because mathematics provides the foundation for all work in the physical and mathematical sciences, particular attention is paid to high school preparation in this subject.

   To decide which mathematics course should be taken first, contact the Mathematics Department, 292 TMCB, and request a mathematics placement test.
2. All students, especially freshmen and those transferring, should contact the department between March and August each year for advisement about efficient course scheduling and opportunities for student employment.

Scholarships

Kenneth W. Brighton, H. Tracy Hall, Ida Tanner Hamblin, and other scholarships are available to qualified chemistry majors.

BA Chemistry (56.5 hours*)

This degree provides an excellent preparation for those individuals in preprofessional programs (e.g., medicine, dentistry, master of business administration, or law), and it also provides career alternatives in chemistry.

Major Requirements

1. No more than 3 hours of D credit is allowed in major courses.
2. The final 10 hours of required chemistry credit must be taken at BYU.
3. Complete the following:
   Chem 111, 112, 113, 201, 227, 351M, 352M, 354, 391, 461, 462, 464, 465.
4. Complete the following:
   Math 112, 113, 302.
   Phscs 121, 123, 220.
5. After consulting with an advisor, complete 4 hours from the following:
   Chem 455, 481M, 496R, 497R, 499R, 514, 518, 521, 523, 552, 553, 561, 563, 565, 567, 569, 594R, 596R.

Recommended Courses

Biol 120.
Math 303.
Phscs 140, 145.

Note: Supporting courses suggested by most medical and dental schools are found in the Preprofessional Advisement section of this catalog. The more rigorous chemistry, mathematics, and physics courses required for the chemistry majors will satisfy the minimum requirements listed there. Elective courses in biochemistry and in biological science are especially pertinent to these preprofessional programs.

*Hours include courses that may fulfill university core requirements.

BS Biochemistry (74.5 hours*)

Students preparing for health-related fields (medicine, dentistry, veterinary medicine) or those who desire an advanced degree (MS, PhD) in biochemistry, biology, or the health sciences receive excellent preparation from this degree program.

Major Requirements

1. No more than 3 hours of D credit is allowed in major courses.
2. The final 10 hours of required chemistry credit must be taken at BYU.
3. Complete the following:
   Chem 111, 112, 113, 201, 227, 351M, 352M, 354, 391, 462, 468, 481M, 482, 584, 586.
4. Complete 1 hour of the following:
   Chem 594R (two enrollments).
5. Complete the following:
   Biol 100**, 340, 360.
   Math 112, 113.
   Phscs 121, 123, 220.
   Stat 221.
6. After consulting with an advisor, complete 4 hours from the following:
   Chem 455, 489, 496R, 497R, 499R, 514, 518, 521, 523, 552, 553, 561, 563, 565, 567, 569, 581, 583, 596R.

   Note: With prior approval, many 400- and 500-level courses in biology, integrative biology, microbiology and molecular biology, and physiology and developmental biology will fill this requirement.

Recommended Courses

Biol 120, 220.
Math 302.

Note: Supporting courses suggested by most medical and dental schools are found in the Preprofessional Advisement section of this catalog. The more rigorous chemistry, mathematics, and physics courses required for the chemistry majors will satisfy the minimum requirements listed there. Elective courses in biochemistry and in biological science are especially pertinent to these preprofessional programs.

*Hours include courses that may fulfill university core requirements.

**See a department advisor for alternatives.

BS Chemistry (74.5 hours*)

This is the preferred degree for chemistry majors (approved by the American Chemical Society) and those who desire an advanced degree (MS, PhD) in chemistry. It also provides

excellent preparation for those individuals in preprofessional programs (e.g., medicine, dentistry, business, law).

Major Requirements

1. No more than 3 hours of D credit is allowed in major courses.
2. The final 10 hours of required chemistry credit must be taken at BYU.
3. Complete the following:
   Chem 111, 112, 113, 201, 227, 351M, 352M, 354, 391, 455, 461, 462, 464, 465, 481M, 514, 518, 521, 523.
4. Complete 1 hour of the following:
   Chem 594R.
5. Complete the following:
   Biol 100**.
   Math 112, 113, 302.
   Phscs 121, 123, 220.
6. After consulting with an advisor, complete 3 hours from the following:
   Chem 482, 496R, 497R, 499R, 552, 553, 561, 563, 565, 567, 569, 584, 586, 596R.

   Note: With approval, certain other 300-level and above courses in the allied fields of physics, statistics, engineering, and biology may be taken to satisfy this requirement.

Recommended Courses

Biol 120.
Math 303.
Phscs 140, 145.
Stat 221.

Note: Elective courses, beyond the requirements above, should be selected in consultation with an advisor. The following should be given consideration: advanced chemistry, foreign languages (especially French, German, Japanese, and Russian), biological sciences, computer science, engineering, mathematics, physics, statistics.

*Hours include courses that may fulfill university core requirements.

**See a department advisor for alternatives.

BS Chemistry Education (79.5 hours*, including licensure hours)

This degree provides preparation for professional high school teaching. High school chemistry teachers will find opportunities available and will know the satisfaction of guiding good students into essential and rewarding careers. Students should work closely with both the Department of Chemistry and Biochemistry and the David O. McKay School of Education Advisement and Certification Office.

Major Requirements

1. No more than 3 hours of D credit is allowed in major courses.
2. The final 10 hours of required chemistry credit must be taken at BYU.
3. Contact the Education Advisement and Certification Office for entrance requirements into the licensure program.
4. A teaching minor is not required for licensure. However, it is strongly recommended.
5. Complete the following:
   Chem 111, 112, 113, 201, 227, 351M, 352M, 391, 462.
6. Complete the following:
   Math 112, 113.
   Phscs 121, 123.
7. Complete 3 hours from the following:
   Chem 354, 464, 465, 497R.
8. Complete 10 hours from the following:
   Biol 100, 150.
   Chem 461, 481M.
   Geol 101 or 111.
   Math 302, 334, 343.
   Phil 423.
   Phscs 140, 145.
9. Complete the Professional Education Component:
   a. Complete the following:
      CPSE 402.
      IP&T 286.
      Sc Ed 276R, 350, 353, 377R, 378, 379.

      Note: Fingerprinting and FBI clearance must be completed before entry into Sc Ed 377R.

   b. Complete 12 hours from one of the following:
      Sc Ed 476R, 496R.

*Hours include courses that may fulfill university core requirements.

Minor Chemistry (17–20 hours*)

Minor Requirements

1. Complete one of the following options:
   Either Chem 111, 112, 113
   Or Chem 105, 106, 107, 223.
2. Complete one of the following options:
   Either Chem 351, 352
   And Chem 353 (2 hours) or 354
   Or Chem 461, 462, 464, 465.

Note: When all of the chemistry credit required for a minor is transferred from another school, at least one course in chemistry must be taken at BYU with a grade of C or better—or the student may request to take a standardized national exam covering advanced material required for the minor. Chemistry programs at some schools have been evaluated, and their credit is acceptable for the minor. No more than one course with a grade in the D range will be allowed.

*Hours include courses that may fulfill university core requirements.

Minor Chemistry Education (15–18 hours*)

Minor Requirements

1. Complete one of the following options:
   Either Chem 111, 112, 113.
   Or Chem 105, 106, 107.
2. Complete the following:
   Chem 201, 351, 352, 353.
3. Complete one course from the following:
   Chem 223, 227, 461, 462, 481.

Note: When all of the chemistry credit required for a minor is transferred from another school, at least one course in chemistry must be taken at BYU with a grade of C or better—or the student may request to take a standardized national exam covering advanced material required for the minor. Chemistry programs at some schools have been evaluated, and their credit is acceptable for the minor. No more than one course with a grade in the D range will be allowed.

*Hours include courses that may fulfill university core requirements.

Chemistry and Biochemistry (Chem)

Undergraduate Courses

100. Elementary College Chemistry. (3:3:0) For nonscience and nonmedical majors. On dem. Independent Study also. Recommended: Phy S 100 or equivalent.
Structure of matter and the chemical consequences of that structure.

101. Introductory General Chemistry. (3:3:0) F, W, Sp, Su Prerequisite: Math 97 or equivalent.
Atomic and molecular structure, periodic relationships, states of matter, chemical reactions and stoichiometry, acids and bases. Primarily for nonscience majors who require a broad introduction to general chemistry.

103. Introductory Chemistry Laboratory. (1:0:3) W Prerequisite: Chem 101 or equivalent.
Introductory laboratory techniques required for simple classical experiments in chemistry.

105. General College Chemistry. (4:5:0) F, W, Sp, Su Prerequisite: Math 110 (or equivalent) or concurrent enrollment.
Atomic and molecular structure including bonding and periodic properties of the elements; reaction energectics, electrochemistry, acids and bases, inorganic and organic chemistry. Primarily for students in engineering and biological sciences. Three lectures and two recitation sections per week.

106. General College Chemistry. (3:4:0) F, W, Su Prerequisite: Chem 105 or equivalent.
Continuation of Chem 105 but covering most of the topics in a more quantitative way. Detailed treatment of thermodynamics and equilibria. Three lectures and one recitation section per week.

107. General College Chemistry Laboratory. (1:0:3) F, W, Sp, Su Prerequisite: Chem 106 or concurrent enrollment.
Chemical properties, chemical reactions, collection and interpretion of data, preparation of reports. Required for most students needing one year of general chemistry.

111. Principles of Chemistry. (3:3:1) F Honors also. Prerequisite: Math 110 (or equivalent) or concurrent enrollment. Strongly recommended: high school chemistry, physics, and introductory calculus or concurrent enrollment in Math 112.
Stoichiometry, kinetic-molecular theory, thermodynamics, states of matter, solutions and equilibria, electrochemistry, structure and bonding, chemical reactions, kinetics. Tutorial included.

112. Principles of Chemistry. (3:3:2) W Prerequisite: Chem 111, or equivalent.
Continuation of Chem 111. Tutorial included.

113. Introductory General Chemistry Laboratory. (2:0:6) F, W Prerequisite: Chem 112 or concurrent enrollment (preferred).
Principles and techniques of chemical measurements. Concepts introduced in general chemistry lecture courses reinforced.

152. Introductory Organic Chemistry. (2:2:0) F, W Prerequisite: Chem 101 or adequate high school preparation in chemistry.
Principles of structure and reactivity, properties and reactions of compound classes, syntheses.

201. Chemical Handling and Safe Laboratory Practices. (0.5:1:0) F 1st blk., W 1st blk., Sp Prerequisite: Chem 113 or 223 or concurrent enrollment.
Safe handling of chemicals and safe practices in chemistry laboratories.

223. Quantitative and Qualitative Analysis. (4:2:6) F, Sp Prerequisite: Chem 106 or equivalent.
Principles of chemical equilibrium, quantitative chemical measurements, and qualitative detection of selected chemical species. Primarily for majors in molecular biology and the life sciences.

227. Introductory Analytical Chemistry. (4:2:6) F, Sp Prerequisite: Chem 113.
Principles of quantitative analysis, introductory instrumental methods, and computer applications to chemical analysis.

285. Introductory Bio-organic Chemistry. (4:4:1) F, W, Sp Prerequisite: Chem 101 or equivalent.
Principles of organic chemistry and biochemistry relating to biomolecule structure and function.

351. Organic Chemistry. (3:3:1) F, W, Sp Prerequisite: Chem 105, 111, or equivalent.
Chemical bonds and molecular structure, conformation and configuration, functional classes, reactions and mechanisms, syntheses. Primarily for majors in chemistry, chemical engineering, and the biological sciences.

351M. Organic Chemistry—Majors. (3:3:0) F Prerequisite: Chem 105, 111, or equivalent.
Chemical bonds and molecular structure, conformation and configuration, functional classes, reactions and mechanisms, syntheses.

352. Organic Chemistry. (3:3:1) F, W, Sp, Su Prerequisite: Chem 351 or equivalent.
Continuation of Chem 351.

352M. Organic Chemistry—Majors. (3:3:0) W Prerequisite: Chem 351M or equivalent.
Continuation of Chem 351M.

353. Organic Chemistry Laboratory— Nonmajors. (1–2:0:6) F, W, Sp, Su Prerequisite: Chem 352 or concurrent enrollment (preferred). For predentistry, premedicine, and other majors who do not intend to take Chem 455.
Physical and chemical properties, isolation and purification, characterization, syntheses.

354. Organic Chemistry Laboratory— Majors. (2:0:6) F, W, Sp Prerequisite: Chem 352 or concurrent enrollment (preferred).
Physical and chemical properties, manipulative skills, isolation and purification, characterization and identification, syntheses.

355. Organic Chemistry Laboratory 2—Nonmajors. (1:0:3) F 2nd blk, W 2nd blk, Sp, Su Prerequisite: Chem 352, 353; or concurrent enrollments.
Physical and chemical properties, isolation, purification, characterization, identification, and syntheses of organic compounds.

391. Technical Writing Using Chemical Literature. (3:3:0) F, W Prerequisite: Chem 227, 352.
Intensive technical writing course based on chemical literature sources. Fulfills GE Advanced Written and Oral Communication requirement.

455. Synthesis and Qualitative Organic Analysis. (3:1:6) F Prerequisite: Chem 354; 201 or concurrent enrollment. For chemistry and other science majors.
Laboratory course emphasizing isolation, purification, and characterization of major and minor products from selected syntheses.

461. Physical Chemistry. (3:3:0) F, W Prerequisite: Chem 227 or Ch En 263 or equivalent; Phscs 123 or concurrent enrollment. Recommended: Math 302.
Thermodynamics and equilibria, states of matter, kinetic-molecular theory, kinetics. May be taken before or after Chem 462.

462. Physical Chemistry. (3:3:0) F, W Prerequisite: Chem 227 or Ch En 263; Phscs 123 or concurrent enrollment.
Quantum mechanics, group theory, atomic and molecular structure, spectroscopy, computational methods, statistical mechanics. May be taken before or after Chem 461.

464. Physical Chemistry Laboratory 1. (1:1:Arr.) F, W Prerequisite: Chem 227; 461, or concurrent enrollment.
Experiments related to physical chemistry: thermodynamics and equilibria, phase transitions, kinetic-molecular theory, kinetics; computer manipulation of data, report preparation. May be taken before, after, or concurrent with Chem 465.

465. Physical Chemistry Laboratory 2. (1:1:0) F, W Prerequisite: Chem 227, 462; or concurrent enrollment.
Experiments related to physical chemistry: quantum mechanics, group theory, atomic and molecular structure, spectroscopy, computational methods, statistical mechanics; computer manipulation of data, report preparation. May be taken before, after, or concurrent with Chem 464.

468. Biophysical Chemistry. (3:3:0) W Prerequisite: Chem 462; 481 or concurrent enrollment. For biochemistry (BS) majors and those interested in the health professions or biochemistry.
Applications of physical chemistry to biological systems. Thermodynamics, equilibria, transport properties, kinetics, spectroscopic applications, computational methods, structural biochemistry.

481. Biochemistry 1. (3:3:0) F, W, Sp Prerequisite: Chem 352; Biol 100 or equivalent. For chemistry majors and students in biological sciences who contemplate pursuing advanced degrees, including medicine.
First-semester biochemistry. Molecular components of cells, chemical structure and function, enzymes, metabolic transformations, photosynthesis.

481M. Biochemistry 1—Majors. (3:3:0) F Prerequisite: Chem 352; Biol 100 or equivalent. For chemistry and biochemistry majors only.
First-semester biochemistry. Molecular components of cells, chemical structure and function, enzymes, metabolic transformations, photosynthesis.

482. Biochemistry 2. (3:3:0) F, Sp Prerequisite: Biol 360; Chem 481 or equivalent.
Second-semester biochemistry. Nucleic acid biochemistry and molecular biology: nucleotide metabolism, chromosome and chromatin structure, DNA structure and replication, RNA transcription and gene expression, protein synthesis and regulation, eukaryotic gene systems, signal transduction.

489. Structural Biochemistry. (3:3:0) On dem. Prerequisite: Chem 481 or equivalent.
Molecular structures of proteins, RNA and DNA as determinants of biological function. Topics include thermodynamics of folding and binding, structural determination, spectroscopy, modeling, protein recognition.

496R. Academic Internship: Chemistry and Biochemistry. (1–6:Arr.:Arr. ea.) F, W, Sp, Su Prerequisite: instructor's consent; Chem 201 or concurrent enrollment or special safety training.
Research experience in an industrial, academic, or government laboratory in collaboration with a BYU faculty colleague/supervisor.

497R. Undergraduate Special Problems. (1–6:Arr.:Arr. ea.) F, W, Sp, Su Prerequisite: instructor's consent and Chem 201 or concurrent enrollment or special safety training.
Undergraduate research experience .

499R. Honors Thesis. (1–6:Arr.:Arr. ea.) F, W, Sp, Su Prerequisite: instructor's consent and Chem 201 or concurrent enrollment or special safety training.

500-Level Graduate Courses (available to advanced undergraduates)

501. Safe Chemical Practices. (0.5:0.5:0) W 1st blk.
University and department safety policies. Chemical hazards, fire safety, and biosafety, including laws.

514. Inorganic Chemistry. (3:3:0) F Prerequisite: Chem 462; or 462, 468; or equivalents.
In-depth treatment of theoretical concepts in inorganic chemistry and the descriptive chemistry of some of the elements.

518. Advanced Inorganic Laboratory. (2:0:6) W Prerequisite: Chem 201 or concurrent enrollment; Chem 514.
Syntheses, characterization, and properties of materials; coordination and organometallic compounds.

521. Instrumental Analysis Lecture. (2:2:0) F Prerequisite: Chem 462 or equivalent.
Modern instrumental methods and basic principles of instrumentation.

523. Instrumental Analysis Laboratory. (2:0:6) W Prerequisite: Chem 521; Chem 201 or 501 or concurrent enrollment.
Continuation of Chem 521. Laboratory experience with modern analytical instrumentation.

552. Advanced Organic Chemistry. (3:3:0) F Prerequisite: Chem 351, 352; 461 or 468; 462; or equivalents.
Physical aspects of organic chemistry; mechanisms, reaction intermediates, bonding, stereochemical and stereoelectronic effects, molecular orbital theory, Lewis acidity and basicity.

553. Advanced Organic Chemistry. (3:3:0) W Prerequisite: Chem 351, 352; or equivalents.
Synthetic aspects of organic chemistry; oxidations, reductions, concerted reactions, stereoselectivity, synthetic equivalents, protecting groups. Examples of natural product total synthesis.

555. Organic Spectroscopic Identification. (3:3:0) F Prerequisite: Chem 352, 354; or equivalents.
Theory and practice of spectrometric methods of identifying organic compounds, including infrared, ultraviolet, nuclear magnetic resonance, and mass spectrometries.

561. Chemical Thermodynamics. (3:3:0) On dem. Prerequisite: Chem 461, 462; or equivalents.
Development of the principles of chemical thermodynamics, including laws, pure materials, mixtures, equilibria, and elementary statistical mechanics.

563. Reaction Kinetics. (3:3:0) W alt. yr. Prerequisite: Chem 461, 462; or equivalents.
Theoretical aspects of chemical kinetics in the gas phase and in solution. Rates and mechanisms in solution, rapid reactions, and other topics.

565. Introduction to Quantum Chemistry. (3:3:0) F Prerequisite: Chem 461 or 468; 462; or equivalents.
Introduction to physical and mathematical aspects of quantum theory, emphasizing application of the Schrodinger wave equation to chemical systems.

567. Statistical Mechanics. (3:3:0) W alt. yr. Prerequisite: Chem 461, 462; or equivalents. Recommended: Chem 565.
Introduction to classical and quantum statistical mechanics, including Boltzmann, Fermi-Dirac, and Bose-Einstein statistics. Applications of statistical thermodynamics to gases, liquids, and solids.

569. Fundamentals of Spectroscopy. (3:3:0) W alt. yr. Prerequisite: Chem 462 or equivalent.
Atomic and molecular spectroscopy and application of group theoretical concepts. Types of experiments and interpretation of data.

581. Advanced Biochemical Methodology 1. (3:3:0) F Prerequisite: Chem 482 or equivalent.
First of two required courses for biochemistry graduate students. Physical methods used in biochemical research, including centrifugation, structural determinations, and use of radioactivity and spectroscopy.

583. Advanced Biochemical Methodology 2. (3:3:0) W
Prerequisite: Chem 482 or equivalent.
Second of two required courses for biochemistry graduate students. Molecular biological methods used in biochemistry, including immunotechniques, bioinformatics, and selected recombinant DNA techniques.

584. Biochemistry Laboratory/Proteins. (3:1:2) F, W Prerequisite: Chem 481 or equivalent.
Introduction to current biochemical research procedures including spectrophotometry, chromatography, electrophoresis, and immunological techniques. Protein over-expression; isolation and characterization methods. Enzyme kinetics and protein-ligand interactions. Introduction to bioinformatics.

586. Biochemistry Laboratory/Nucleic Acids. (3:1:2) F, W
Prerequisite: Chem 482 or equivalent.
Laboratory course covering major techniques involved in isolation, amplification, and cloning of recombinant DNA as well as isolation, synthesis, translation, and identification of RNA.

594R. General Seminar. (0.5:1:0 ea.) F, W
Research topics presented by faculty and visiting scientists. Required every semester in residence of all senior BS majors and graduate students in chemistry and biochemistry.

596R. Special Topics in Chemistry. (1–3:3:0 ea.) On dem.

Graduate Courses

For 600- and 700-level courses, see the 2007–2008 BYU Graduate Catalog.

Chemistry and Biochemistry Faculty

Professors
Andrus, Merritt B. (1997) BS, Brigham Young U., 1986; PhD, U. of Utah, 1991.
Boerio-Goates, Juliana (1981) BA, Seton Hill Coll., 1975; MS, PhD, U. of Michigan, 1977, 1979.
Burton, Gregory F. (1997) BS, U. of Utah, 1975; MS, Brigham Young U., 1985; PhD, Virginia Commonwealth U., 1989.
Dearden, David V. (1994) BS, Brigham Young U., 1983; PhD, California Inst. of Technology, 1989.
Eatough, Delbert J. (1971) BS, PhD, Brigham Young U., 1964, 1967.
Farnsworth, Paul B. (1981) BS, Brigham Young U., 1977; PhD, U. of Wisconsin, Madison, 1981.
Fleming, Steven A. (1985) BS, U. of Utah, 1978; PhD, U. of Wisconsin, Madison, 1984.
Goates, Steven R. (1981) BS, Brigham Young U., 1976; MS, PhD, U. of Michigan, 1977, 1981.
Lamb, John D. (1985) BS, PhD, Brigham Young U., 1971, 1978.
Lee, Milton L. (1976) BA, U. of Utah, 1971; PhD, Indiana U., 1975.
Nordmeyer, Francis R. (1972) BA, Wabash Coll., 1961; MA, Wesleyan U., 1964; PhD, Stanford U., 1967.
Savage, Paul B. (1995) BS, Brigham Young U., 1988; PhD, U. of Wisconsin, 1993.
Simmons, Daniel L. (1989) BS, MS, Brigham Young U., 1978, 1980; PhD, U. of Wisconsin, Madison, 1986.
Willardson, Barry M. (1996) BA, Brigham Young U., 1984; PhD, Purdue U., 1990.
Woolley, Earl M. (1970) BS, PhD, Brigham Young U., 1966, 1969.
Zimmerman, S. Scott (1978) BS, Brigham Young U., 1969; PhD, Florida State U., 1973.

Associate Professors
Graves, Steven W. (1998) BA, U. of Utah, 1969; MPhil, PhD, Yale U., 1972, 1978.
Harrison, Roger G. (1995) BS, Utah State U., 1986; PhD, U. of Utah, 1993.
Linford, Matthew R. (2000) BS, Brigham Young U., 1990; PhD, Stanford U., 1996.
Peterson, Matt A. (1995) BS, Utah State U., 1987; PhD, U. Of Arizona, 1992.
Shirts, Randall B. (1991) BS, Brigham Young U., 1972; AM, PhD, Harvard U., 1978, 1979.
Woodfield, Brian F. (1997) BS, MS, Brigham Young U., 1986, 1988; PhD, U. of California, Berkeley, 1995.
Woolley, Adam T. (2000) BS, Brigham Young U., 1992; PhD, U. of California, Berkeley, 1997.

Assistant Professors
Asplund, Matthew C. (2000) BS, Brigham Young U., 1992; PhD, U. of California, Berkeley, 1998.
Austin, Daniel E. (2005) BS, Brigham Young U., 1998; PhD, California Inst. of Technology, 2002.
Belnap, David M. (2004) BS, Brigham Young U., 1989; PhD, Purdue U., 1995.
Buskirk, Allen R. (2004) BS, Brigham Young U., 1999; PhD, Harvard U., 2004.
Castle, Steven L. (2002) BS, Brigham Young U., 1995; PhD, The Scripps Research Inst., 2000.
Hansen, Jaron C. (2005) BS, Utah State U., 1997; PhD, Purdue U., 2002.
Sevy, Eric T. (2001) BS Brigham Young U., 1994; MA, MPhil, PhD, Columbia U., 1995, 1998, 1999.
Vollmer-Snarr, Heidi R. (2002) BS, U. of Utah, 1997; DPhil, Oxford U., England, 2000.

Associate Teaching Professors
Brown, Philip R. (1999) BS, PhD, Brigham Young U., 1982, 1986.
Hinshaw, Barbara C. (1989) BA, Westminster Coll., 1966; MS, U. of Utah, 1969.
Wood, Steven G. (2001) BS, MS, PhD, Brigham Young U., 1973, 1975, 1983.

Assistant Teaching Professor
Nielson, Jennifer (2004) BS, Brigham Young U., 1988; MS, PhD, U. of California, San Diego, 1992, 1997.

Assistant Research Professor
Herron, Steven R. (2004) BS, Brigham Young U., 1992; MS, U. of California, Riverside, 1995; PhD, U. of California, Irvine, 2001.

Emeriti
Bills, James L. (1963) BS, U. of Utah, 1958; PhD, Massachusetts Inst. of Technology, 1963.
Blackham, Angus Udell (1952) BA, Brigham Young U., 1949; MA, PhD, U. of Cincinnati, 1950, 1952.
Bradshaw, Jerald S. (1966) BS, U. of Utah, 1955; PhD, U. of California, Los Angeles, 1963.
Broadbent, H. Smith (1946) BS, Brigham Young U., 1942; PhD, Iowa State U. of Science and Technology, 1946.
Butler, Eliot A. (1956) BS, PhD, California Inst. of Technology, 1952, 1956.
Cannon, John Francis (1970) BS, PhD, Brigham Young U., 1965, 1969.
Cluff, Coran L. (1960) BS, Northern Arizona U., 1952; MS, PhD, U. of Michigan, 1955, 1961.
Dalley, Nelson Kent (1968) BS, MS, Brigham Young U., 1960, 1964; PhD, U. of Texas, Austin, 1968.
Goates, J. Rex (1947) BS, Brigham Young U., 1942; PhD, U. of Wisconsin, Madison, 1947.
Hall, H. Tracy (1955) BS, MS, PhD, U. of Utah, 1942, 1943, 1948.
Hansen, Lee Duane (1972) BS, PhD, Brigham Young U., 1962, 1965.
Hawkins, Richard T. (1959) BA, Brigham Young U., 1951; PhD, U. of Illinois, 1959.
Izatt, Reed M. (1956) BS, Utah State U., 1951; PhD, Pennsylvania State U., 1954.
Kuchar, Marvin C. J. (1979) AA, Eastern Arizona Coll., 1955; BS, PhD, Brigham Young U., 1957, 1963.
Mangelson, Nolan F. (1969) AS, Snow Coll., 1959; BS, Utah State U., 1961; MS, Brigham Young U., 1963; PhD, U. of California, Berkeley, 1967.
Mangum, John H. (1963) BS, MS, Brigham Young U., 1957, 1959; PhD, U. of Washington, 1963.
Nelson, K. LeRoi (1956) BS, Utah State U., 1948; PhD, Purdue U., 1952.
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Chinese

See Asian and Near Eastern Languages.

Church History and Doctrine

See Religious Education in Academic Departments, Degrees, and Courses section of this catalog.

Civil and Environmental Engineering

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Admission to Degree Program

The degree program in the Department of Civil and Environmental Engineering is open enrollment.

The Discipline

The BYU Department of Civil and Environmental Engineering prepares students for professional involvement in structural, water resources, environmental, geotechnical (soils), and transportation engineering.

Structural engineers analyze and design buildings, bridges, offshore oil platforms, aircraft, and artificial limbs. The engineer applies principles of physics, mathematics, and engineering to develop efficient yet safe designs. Sophisticated computer models are used in these analyses. Materials used by structural engineers include steel, aluminum, concrete, wood, graphite, fiberglass, kevlar, ceramics, and plastics.

Water resource and environmental engineers design pipeline systems, water treatment plants, dams, flood control structures, waste disposal sites, and environmental restoration projects. Computer modeling and analyses are used in design and to forecast storm runoff, flooding, and movement of contaminants in surface and subsurface waters.

Environmental engineers evaluate and reduce pollutants from natural, human, agricultural, and industrial sources to preserve the beauty and quality of air, land, and water.

Geotechnical engineers design structures composed of or located within earth materials, including foundations for buildings and bridges, retaining walls, earth dams, highway embankments, tunnels, and liners for landfills. Field and laboratory tests on soil and rock, along with empirical and computer models, are used to assure safety and economy in design.

Traffic and transportation engineers apply scientific principles to the planning, design, construction, operation, and management of transportation systems, including highways, airports, and mass transit facilities. Transportation engineers are responsible for the safe, rapid, comfortable, convenient, economical, and environmentally compatible movement of people and goods. Computer models and simulations are frequently used by traffic engineers for geometric design and for planning, operating, and managing transportation networks, including intermodal systems. Next to national defense, transportation is the largest sector in the U.S. economy, accounting for approximately 16 percent of the gross domestic product (GDP); many engineers work in this field.

Educational Objectives

The objective of the undergraduate program in civil and environmental engineering is to develop the following attributes in students graduating from the program:

1. An understanding of fundamental principles of mathematics and science.
2. An understanding of fundamental engineering science.
3. An understanding of geotechnical engineering.
4. An understanding of structural engineering.
5. An understanding of transportation engineering.