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### Chemistry

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*Click here for [Chemistry courses](#).*

Chemistry is the science concerning the control, properties, reactivity, and detection of atoms and molecules in the world around us. Just as chemistry contributes to our existence, culture, and our quality of life, the discipline of chemistry is the central science with new frontiers continually being explored from which new benefits result. As home to the central science, the department serves the entire student population in addition to chemistry majors in a well-equipped state-of-the-art facility that is part of the TCNJ Science Complex. Consistent with the goals of TCNJ, the chemistry faculty members have substantial contact with each student. Faculty advisors meet regularly with students to assist in defining educational paths that will best allow the pursuit of career goals. Student development is enhanced through a thorough seminar program which includes discussions of the roles and responsibilities of chemists in today's society. Additionally, students have the opportunity to participate in research programs with faculty members in each sub-discipline of chemistry.

Many TCNJ chemistry majors pursue advanced degrees in analytical, organic, inorganic, physical chemistry, or biochemistry at leading graduate programs throughout the country. Graduates are also well-suited for entrance into dental, medical, and other professional schools. The program prepares students for pursuing careers in the rapidly changing chemical industry, teaching careers, and careers in state and national government laboratories. Students interested in pursuing a career in pharmaceutical sales and marketing can combine a major in chemistry with a minor in marketing. A forensic chemistry concentration is available as well to further broaden the career options for graduates.

The Chemistry Department has a strong sense of community with a strong Student Chemist's Association (ACS Student Affiliates) and a chapter of the National Chemistry Honor Society, Gamma Sigma Epsilon. Students completing the chemistry major will receive a Bachelor of Science degree. Students planning to pursue a career in chemistry or allied fields are strongly encouraged to complete the requirements for an American Chemical Society approved Bachelor of Science degree.

Transfer students are required to take a minimum of four course units of chemistry (courses numbered CHE 300 or above) for graduation as chemistry majors from The College of New Jersey.

Those students wishing to earn a honors designation in chemistry may do so by successfully completing a series of ACS examinations and a research project.

### Recommended High School Preparation

A curriculum which develops and sharpens **problem solving** and **critical thinking** skills is paramount. Based on the interdisciplinary nature of modern chemistry, a good level of high school preparation for an entering chemistry major at TCNJ includes a year each of college preparatory or AP level chemistry, physics, biology, and four years of mathematics. The quantitative nature of chemistry requires a solid mathematics background encompassing as much mathematics as possible, including algebra, geometry, trigonometry, and calculus, if available. Experience with word processing, spreadsheets, and presentation software is helpful, as is coursework or outside experience in computer programming. Four years of English encompassing solid writing skills are also important to success in the study of chemistry. Since graduate study in chemistry toward a PhD degree often requires a reading knowledge of a modern foreign language (usually German, French or Russian), foreign language study should begin in high

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school. Four years of study of a single language would permit the prospective student potential flexibility with regard to course selection while at TCNJ.

### AP Scores

The Chemistry Department policy is for all student course selections to be made by the student in consultation with his/her academic advisor and/or the department chair. An AP score of 4 garners credit for CHE 201, General Chemistry I. An AP score of 5 results in credit for both CHE 201 and 202, General Chemistry I and II. While students with a chemistry AP score of 5 may receive credit for CHE 201 and CHE 202, the department recommends that they take CHE 202 or HON 202 before enrolling in higher-level Chemistry courses. We make this recommendation for the following reasons. 1) General Chemistry provides the foundation for higher-level chemistry courses, yet many students take AP chemistry their junior year in high school and find that they have forgotten much of the material by their freshmen year in college. 2) Higher-level chemistry courses expect a high level of competency in the lab that is normally gained in CHE 201 and 202. Most high school chemistry courses do not provide the laboratory experience needed for students to operate comfortably in higher-level laboratory sections. 3) Freshman year is a period of adjustment and many freshmen lack the emotional maturity and the study skills required for the demanding upper-level chemistry courses. Simply reading the chapters will not lead to success. Mastery of these subjects requires that a good deal of time (10-12 hours/week minimum) be invested into working problems and participating in small group studies outside of class. 4) Our experience is that freshmen who take Organic or Analytical Chemistry their first semester at TCNJ generally perform poorly.

Should anyone with an AP score of 5 in chemistry enroll directly in higher-level courses his/her freshmen year? Students with a strong high school laboratory background, AP credit in physics or mathematics, a high level of personal maturity, and excellent study skills may enroll directly in courses such as CHE 310 (Analytical Chemistry) or CHE 331 (Organic Chemistry I). However, as stated above, all decisions about course enrollment should be made with the student's academic advisor or the department chair. Additional course enrollment options may be discussed at that time.

### Department Policy on Repeating a Course

In the event a student wishes to repeat any course in chemistry, the student is exempted from repeating the laboratory component only if the course was passed with a grade of D or better and the lab average was 80% or better. Should a student fail a course and wish to repeat, the lab component must be repeated regardless of the lab average.

After completing a chemistry course twice, a student may not register for the course again unless approved by the department chair. After registering for a chemistry course three times, a student may not register for the course again unless approved by the department chair. (Registering includes both completing a course and withdrawing from a course.) Note that in either case, approval by the department chair will only be granted under extenuating circumstances, such as the student suffered a severe illness or experienced the death of a family member while taking the chemistry course.

### Progression in the Chemistry Course Sequence

Enrollment in CHE 201, CHE 202, CHE 310, CHE 331, and CHE 332 requires that the student have a minimum grade of C- in the pre-requisite courses. The Chemistry Department has found that students with grades lower than C- in pre-requisite courses tend to fail the subsequent course. If, after semester grades have been issued, students discover that they will not meet this requirement, they must de-register for the subsequent course. For example, a student who has registered for CHE 202 but completes CHE 201 with a grade of D+ must de-register for CHE 202 and, if possible, repeat CHE 201. If a

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student fails to de-register under these circumstances, the Chemistry Department will de-register the student to make that seat available. Any student enrolled in these courses in violation of this rule will be considered to be in violation of the Student Conduct Code.

### Program Entrance, Retention, and Exit Standards

Every major program at the College has set standards for allowing students to remain in that program, to transfer within the College from one program to another, and to graduate from a program. The following are the standards for chemistry programs.

Minimum grades are noted in parentheses:

- Retention in the program is based on the following performance standards in these “critical content courses”: CHE 201 and 202/General Chemistry I and II (C); CHE 331/Organic Chemistry I (C) and CHE 310/Analytical Chemistry (C).
- Students wishing to transfer into the Chemistry major from another department or program at TCNJ must meet the following minimum requirements:
  - Completed a minimum of one semester at TCNJ. This must include one Chemistry course.
  - A “C” or better in all Chemistry and correlate courses taken at TCNJ.
  - TCNJ GPA of 3.0 or higher.

Note that students must fill out a transfer of major form and file it with the Chemistry Department office no later than the 4th week of the semester.

Admission decisions are made once a semester prior to the registration period for the following semester. Admission is based on the number of seats available and the qualifications of the applicant.

- Graduation requires a GPA of 2.0 in courses required for the major.

### Programs within Chemistry

There are six programs within the major under the following categories: Liberal Arts, Secondary Education, Seven-year BS Chemistry/MD Program, Elementary Education M/S/T or Early Childhood Education M/S/T or Deaf and Hard of Hearing M/S/T with a chemistry specialization. Please note that while the Seven-year BS Chemistry/MD Program will be offered starting fall semester 2013, it is not the typical route to a medical degree. Typically, students complete a four-year bachelor's degree in biology, chemistry, or another major prior to starting medical school. See the section below titled “Pre-Health Profession Option for Chemistry Majors.”

Within the Liberal Arts program, students may pursue a Specialization in Forensic Chemistry. In both the Liberal Arts and Secondary Education programs, students may pursue ACS or Non-ACS approved degrees. While a brief description of these options is provided here, students should seek guidance from their academic advisors.

- **Forensic Chemistry Specialization.** Students interested in crime lab work, industrial forensics, analytical chemistry, and graduate programs in chemistry
- **ACS approved degree with research.** Students interested in industry, a graduate degree in chemistry or related fields, undecided.
- **ACS approved degree without research.** Students interested in working in industry at a bachelor's level, students pursuing advanced degrees in health, law, business, etc.
- **Non-ACS approved degree.** Students pursuing secondary education or minor(s)/double-major.
- **Seven-year BS Chemistry/MD Program.** Students majoring in chemistry and admitted as freshmen to the TCNJ/ UMDNJ/NJMS seven-year BS/MD program. See [7-Year Medical Program](#) for general information about the BS/MD program.

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Freshmen will be enrolled in the Liberal Arts program, ACS approved degree with research, CHEM\_BS\_01, the Secondary Education program, Non-ACS approved degree, CHEM\_BS\_06, or in the Seven Year BS Chemistry/MD Program, CHEM\_BS\_08. Enrollment in Secondary Education must be completed no later than the second semester of freshman year in order to complete the degree in four years.

### Chemistry Major (Liberal Arts or Secondary Education)

#### Core (9.5 Course Units)

CHE 201, 202/General Chemistry I, II	2 course units
CHE 310/Analytical Chemistry	1 course unit
CHE 331, 332/Organic Chemistry I, II	2 course units
CHE 371/Quantum Chemistry	1 course unit
CHE 372/Chemical Thermodynamics	1 course unit
CHE 430/Biochemistry	1 course unit
CHE 451/Inorganic Chemistry—Structure and Bonding	1 course unit
CHE 099, 316, 317 Chemistry Seminars	0.5 course unit

#### Correlate (4 Course Units)

MAT 127, 128/Calculus A, B	2 course units
PHY 201, 202/Physics I, II	2 course units

#### Options (5 or 3 Course Units) *See course descriptions for prerequisites.*

CHE 340 History of Chemistry and Physics
CHE 360 Forensic Chemistry
CHE 365 Environmental Chemistry
CHE 393 Independent Research I
CHE 410 Advanced Analytical Chemistry, Instrumental Analysis
CHE 415 Separation Science
CHE 452 Inorganic Chemistry-Reactions and Mechanisms
CHE 457 Organometallic Chemistry Laboratory
CHE 470 Advanced Topics in Chemistry
CHE 471 Forensic Applications of Mass Spectrometry
CHE 472 Forensic Chemistry II
CHE 493 Independent Research II

#### The ACS-certified chemistry degree with research (5 chemistry options total)

1 Chemistry option 300 or 400 level with or without laboratory\*

2 Chemistry options 400 level with or without a laboratory

CHE 393 Independent Research I

CHE 493 Independent Research II

The independent research completes the laboratory hours required by the ACS (400 total hours).

\* A second semester of CHE 493 Independent Research II may substitute for this requirement. Courses outside the department can be substituted upon approval by the department chair. A pre-approved list of courses outside the department may include Genetics, Immunology, Mathematical Physics, Linear Algebra, and Modern Physics.

#### The ACS-certified chemistry degree without research (3 chemistry options total)

1 Chemistry option 300 or 400 level with laboratory\*

2 Chemistry options 400 level with laboratory (CHE 410 is strongly recommended)\*

\*All three chemistry options must have a laboratory component to complete the laboratory hours required by the ACS (400 total hours).

#### The non-ACS certified chemistry degree (3 Chemistry options total)

1 Chemistry option 400 level with or without laboratory

2 Chemistry options 300 or 400 level with or without laboratory\*

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\*One course outside the department may be substituted with the approval by the department chair. A pre-approved list of courses outside the department may include genetics, immunology, mathematical physics, linear algebra, modern physics, or student teaching.

### **The Seven-year BS Chemistry/MD Program degree (3 Chemistry options total)\***

BIO 231 Genetics (counts as Chemistry Option I)

Biochemistry at NJMS (counts as Chemistry Option II)

Medical Physiology at NJMS (counts as Chemistry Option III)

\*This is a non-ACS certified Chemistry degree.

### **The Forensic Chemistry Specialization—Program Description**

The Forensic Chemistry Specialization builds on a complete BS degree in chemistry and currently is open to majors in the Chemistry Department. Completion of the concentration leads to BS chemists who can pursue a wide range of careers or graduate education in chemistry, and who also have insights into chemical aspects of the applied field of forensic science.

To complete the Forensic Chemistry Specialization, students must complete the following program in addition to all requirements for the BS in chemistry program: 1) two criminology courses (CRI 200 and 203, or 201 and 203); 2) a research experience or internship in a related area is highly recommended; and 3) two forensic chemistry courses, one of which must be CHE 360, the other may be either CHE 471, Forensic Applications of Mass Spectrometry or CHE 472, Forensic Chemistry II. The CRI courses are considered as correlate courses to the specialization. All three forensic chemistry courses will have an accompanying laboratory. In addition, students completing the concentration are encouraged to attend a meeting in a related area such as the American Academy of Forensic Sciences Annual Meeting.

To enroll in the program, students should identify Chemistry, Liberal Arts as their major and the Forensic Chemistry Specialization as their second major/concentration.

### **Chemistry Secondary Education**

The Chemistry Secondary Education student must complete the requirements for an ACS or a Non-ACS approved major, as listed above. In addition to meeting the requirements for the major, the Chemistry Secondary Education student must meet the requirements of liberal learning, the professional education sequence (see below), and state certification. This requires careful course planning with the student's academic advisor(s) starting with the first semester of classes. To be retained in the Chemistry Secondary Education program, a student must earn at least a 2.5 cumulative grade point average (CGPA) before enrolling in the junior year education sequence. The student must also establish a minimum 2.75 CGPA before he/she is allowed to student teach (CHE 490). **NOTE:** *A student wishing to obtain Physical Science Certification must replace the CHE 300 level course with an Advanced Physics course and take a second Advanced Physics course.*

Teacher education candidates must establish a minimum 2.75 GPA in order to be allowed to student teach. Candidates for a teacher-education certificate must have a 2.75 or higher cumulative grade point average to successfully complete their teacher education program. They also must meet the state hygiene/physiology requirement, the state Harassment, Intimidation, and Bullying Prevention (HIB) training certificate requirement, and pass the appropriate Praxis examination. Teacher-education candidates will receive a "certificate of eligibility with advanced standing" which requires a candidate to be provisionally certified for his or her first year of teaching. After one year of successful teaching, the candidate is eligible for a permanent certificate.

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An overview of the entire secondary-level teacher preparation sequence for students can be found in the section of this bulletin for the [Department of Education Administration and Secondary Education](#).

### Professional Education Sequence (9 Course Units)

SED 224/Adolescent Learning and Development	1 course unit
EFN 299/School and Communities	1 course unit
SED 399/Pedagogy in Secondary Schools	1 course unit
PHY 390/Methods of Teaching Science	1 course unit
SPE 323/Secondary Content Literacy in Inclusive Classrooms	1 course unit
EFN 398/Historical and Political Context of Schools	1 course unit
CHE 490/Student Teaching	2 course units
SED 498/Collaborative Capstone for Professional Inquiry	1 course unit

### First-Year Sequence\*

#### Fall Semester

FSP First Seminar
CHE 099/Orientation to Chemistry
XXX Liberal Learning/Language**
CHE 201/General Chemistry I
MAT 127/Calculus A

#### Spring Semester

CHE 202/General Chemistry II
MAT 128/Calculus B
PHY 201/General Physics I
WRI 102/Academic Writing***

\*Actual courses will vary with advisement and course availability.

\*\* It is recommended that students exempted from the language requirement take another liberal learning course. Note: Arabic 151 and 152, Chinese 151 and 152, Japanese 151 and 152, and Russian 151 and 152 (offered annually); and Persian 151 and 152 (offered occasionally) are intensive courses and carry two course units of credit each. Students should take this into account when planning a normal four-course semester.

\*\*\*It is recommended that students exempted from this course take another liberal learning or language course. Students in the Seven-year BS Chemistry/MD Program should take BIO 185 Themes in Biology.

### Pre-Health Profession Option for Chemistry Majors

Students interested in health-related careers such as medicine, dentistry, pharmacy, etc. may study for admission to these professional schools through the chemistry liberal arts major. Careful selection of courses within this major and within free electives will prepare the student to meet health professional school admission requirements. (See also [Medical Career Advisory Committee](#).)

### Chemistry Minor

A minor in chemistry is comprised of five full courses in CHE courses including CHE 202 (or Honors CHE 202) and four other CHE courses numbered 300 or higher, but not including CHE 316, 317, 318, 393, 399, or 490. The minimum grades in CHE 201, CHE 202, and CHE 331 and the minimum GPA for retention and completion of the minor are the same as for the major.

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### **Elementary Education M/S/T or Early Childhood Education M/S/T or Deaf and Hard of Hearing M/S/T with a Chemistry Specialization**

The M/S/T interdisciplinary major integrates formal study in mathematics, science, and technology to gain a better understanding of the human-designed world in which we all live. The major consists of nine units of courses drawn from a common “core”, one approved M/S/T elective, and a four-unit “specialization” in one of the M/S/T disciplines. Students in the major receive careful course selection advisement so that they qualify for a middle school endorsement in one of the M/S/T disciplines. **All majors must see the M/S/T academic program coordinator for general advisement.**

Students electing a Chemistry Specialization within the MST major will complete MAT 127/128 Calculus A/B, CHE 201/202 General Chemistry I/II, one approved non-chemistry science course, ETE 261/Multimedia Design, ETE 271/Structures and Mechanics, MAT 105/Mathematical Structures and Algorithms for Educators I, TED 460/Integrated M/S/T for the Child/Adolescent Learner, and one M/S/T approved electives. The Chemistry Specialization consists of CHE 331/332 Organic Chemistry I/II, a chemistry elective at the 300 level or above, and an approved elective supporting middle school endorsement.

### **M/S/T Suggested First Year Course Sequence (8 Course Units)**

FSP	First Seminar	1 course unit
MAT	127/Calculus A	1 course unit
TST	161/Creative Design	1 course unit
ETE	261/Multimedia Design	1 course unit
	Science Option #1 (by advisement)	1 course unit
	Math or Science Option (by advisement)	1 course unit
MAT	105/Mathematical Structures and Algorithms for Education I	1 course unit
WRI	102/Academic Writing (if not exempt)*	1 course unit

### **Study Abroad**

Students pursuing a degree in chemistry have the option to study abroad for a semester. Any student interested in studying abroad should meet with his/her faculty advisor before the sophomore year in order to plan a curriculum so that the student may complete his/her studies in four years. An appointment with the college's [Center for Global Engagement](#) is also required. The student must receive approval from the chair of chemistry in order for courses taken abroad to count toward requirements for the major.