

GRADUATE PROGRAMS CHEMISTRY

The [Department of Chemistry](#) at ESF is unique in that it is structured around four areas of application:

- [Biochemistry](#)
- [Environmental Chemistry](#)
- [Organic Chemistry of Natural Products](#)
- [Polymer Chemistry](#)

Faculty members in the department are internationally recognized experts and are well funded by federal agencies (NSF, DOE, NASA, etc.), industry, government, and NGOs. Graduate students commonly receive national fellowships. The environment for graduate students is challenging but supportive, as faculty are invested in student success.

Graduate degrees require an appropriate program of courses at ESF and Syracuse University. Master of Science and doctoral students must complete a minimum of 18 credit hours and 30 credit hours of graduate level coursework, respectively. In addition, doctoral students must pass a doctoral candidacy examination.

Current research projects encompass natural and synthetic polymer chemistry, biochemistry and microbiology; organic chemistry of natural products and chemical ecology; chemistry of air and water; climate change.

Masters in Professional Studies (M.P.S.) Degree

The [Masters in Professional Studies](#) is a coursework-based program intended for students who need additional courses in Chemistry, but who are not planning on pursuing a research career in the field. M.P.S. students take courses in any of the subject areas of the department: Biochemistry, Environmental Chemistry, Inorganic Chemistry, Natural Products/Organic Chemistry and Polymer Chemistry. The curriculum is sufficiently flexible to allow a student interested in specializing in one of these areas to take the core sequence in that area, although this is not required. Students who have taken any of these courses as undergraduates may not repeat them for graduate credit.

All students entering graduate programs at ESF are expected to be proficient in communication skills, including technical writing and library skills. This requirement can be met by completing at least one course in technical writing and one course in library usage, either as an undergraduate or as a graduate student. Alternatively, graduate students can meet the requirement by demonstrating the equivalent in experience in writing and library skills, as determined by the steering committee.

In addition to the formal coursework, the M.P.S. program also requires an integrative experience that allows the student to synthesize their knowledge. This can be a detailed analysis of one particular area of chemistry, an independent study, internship with industry, or work in a research laboratory. The integrative experience should be approved by the student's steering committee prior to starting. The student will be expected to present a written final report on the integrative experience.

M.P.S. Program Requirements

The Master of Professional Studies (M.P.S.) degree requires a total of 30 credits (minimum) in the following configuration:

Area	Credits
Chemistry	15
Other sciences, engineering and mathematics	6
Seminars	3
Integrative experience (internship or independent study)	3
Elective coursework, seminars, internships or research experience	3
Total (minimum)	30

- **15 credits of graduate chemistry courses**, including chemistry courses are available at ESF and Syracuse University.
- **6 credits of graduate coursework in Science, Mathematics or Engineering**. These may include graduate courses offered at ESF or Syracuse University in physical or biological sciences, mathematics (including statistical analysis), or any area of engineering. Courses must be approved by the student's steering committee.
- **3 credits of seminar**: Either FCH 797 Graduate Seminar may be repeated, or students may choose seminars offered in other departments with approval of the advisor.
- **3 credits for an integrative experience** as FCH 898, Professional Experience/Synthesis in Chemistry.
- **3 credits of additional graduate coursework**: These remaining three credits may be drawn from additional graduate level coursework, seminars, internships and research experience as approved by the student's steering committee.

M.S. & Ph.D. Degrees

The Biochemistry, Environmental Chemistry, and Polymer Chemistry options each have a core sequence of courses that are required for all graduate students in that option. All graduate students must present a public department seminar through FCH 797 plus a capstone seminar.

General Requirements

Steering committee and program of study: By the end of their first year of study, all graduate students must formally identify the two faculty who, in addition to their major professor, will provide guidance for their graduate school career. These two faculty and the major professor constitute the steering committee. These faculty must approve the student's program of study: the list of courses the student will take for their degree. This approval must also occur by the end of the first year. Forms are available online at students' MyESF page.

M.S. Program Requirements

M.S. students are required to take at least 18 credits of coursework or non-thesis research; some options require additional credits. While a certain number of research credits are required, successful completion of an M.S. thesis project is determined by effort and effectiveness, not by credits.

Ph.D. Program Requirements

Ph.D. students are required to take at least 30 credits of coursework or non-dissertation research; some options require additional credits. While a certain number of research credits are required, successful completion of a Ph.D. dissertation project is determined by effort and effectiveness, not by credits.

The candidacy exam at ESF has three formats, but Chemistry usually uses format 2 (research report) or format 3 (the thesis proposal). After authoring the document, students defend it orally in front of their steering committee and one or two examiners.

Areas of Study

There are five graduate areas of study in Chemistry:

Biochemistry (M.P.S., M.S., Ph.D.)

Graduate studies in biochemistry reflect the College's interests in microbial, insect, bio-based fuel, and plant biochemistry.

After completing a one-year sequence in general biochemistry, students select advanced courses from a range of offerings in chemistry, organismal biology and molecular biology. Advanced courses in biochemistry are available both at ESF and Syracuse University.

Environmental Chemistry (M.P.S., M.S., Ph.D.)

The ESF program offering M.S. and Ph.D. degrees in chemistry with an emphasis in environmental chemistry is one of the few doctoral programs of its type within a chemistry department in the United States. The nine core faculty and two participating faculty make it one of the largest such programs in the world.

Students take three core courses in environmental chemistry and one course in biochemistry. Subsequent coursework is carefully selected from regularly offered courses on oceanography, biogeochemistry, analytical methods, sustainability, environmental health and basic areas of chemistry. Coursework is also available in ecology, biology, geology, math and engineering.

Research in environmental chemistry spans a wide range, from fieldwork to laboratory work to computer modeling. Areas of research include global climate change, coral reef ecosystems, biogeochemistry, atmospheric chemistry, regional and global air quality, and transient and persistent organic pollutants. The program avoids a "pollutant of the week" approach that would leave graduates unprepared for future developments. Instead, it emphasizes a framework wherein students can incorporate new knowledge as it becomes available and deal with new problems as they are discovered.

Organic Chemistry of Natural Products (M.P.S., M.S., Ph.D.)

Graduate students in organic chemistry of natural products take a one-year course sequence in mechanistic organic chemistry and another in synthetic organic chemistry. Additionally, one-semester courses are required in physical chemistry and the organic chemistry of natural products.

Courses in biochemistry, inorganic chemistry, statistics and specialized courses in chemistry or biology may be arranged and selected by the student in consultation with faculty.

Research in the field of organic chemistry of natural products takes three paths. These paths are the isolation and characterization of new natural substances; the synthesis of new or improved syntheses of better-known natural substances; and the study of the relation of molecular structure to biological response. Chemical research in each of these areas is coupled with biological testing. Research involving isolation and synthetic chemistry requires the student to develop expertise in separation techniques, such as the several methods of chromatography and spectrometric identification of molecules. Successful investigation in structure/activity relationships requires the student to become familiar with statistical methods of analysis.

Polymer Chemistry (M.P.S., M.S., Ph.D.)

Graduate students in polymer chemistry select their courses from a range of offerings in chemistry, chemical engineering, mathematics, physics, and other appropriate areas. These courses include the one-year sequence in the physical and organic chemistry of polymers and such additional courses as the student and advisor consider necessary.

Special topics in a spectrum of polymer fields are offered or can be arranged in consultation with the faculty.

Chemical Ecology (M.S., M.P.S., Ph.D.)

Chemical ecologists study organismal interactions, both intra- and interspecific, mediated by chemical substances. These interactions occur among microbes, plants, and animals. Study of such interactions typically involves joint efforts of biologists and chemists in basic and applied research in the laboratory and field. The application of chemical ecology has contributed significantly to reduced pesticide use and improved yields in forestry and agriculture while protecting the environment from harmful contaminants.

The study of chemical ecology is offered through collaboration between the Department of Environmental Biology and the Department of Chemistry. Interested students should apply to the department of major interest. Faculty from both areas contribute to the development of a plan of study enabling each student to acquire advanced skills in either biology or chemistry and an ample understanding of the other field to grapple with problems requiring an understanding of both.

