

# PHYSICAL SCIENCES

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## Graduate Faculty

**Professors:** James Aber, Jorge Ballester, Robert Jones, Marcia Schulmeister, Richard Sleezer, Kenneth Thompson.

**Associate Professors:** Michael Morales, Christopher Pettit, Eric Trump, Kim Simons.

**Assistant Professors:** Claudia Aguirre-Mendez, Alivia Allison, Christine Morales, Diane Nutbrown.

## Introduction

Graduate study with concentrations in chemistry, earth science, physics, and physical sciences is offered within the Master of Science degree.

The requirements for each of these concentrations are described separately. Each is designed to promote a high level of competence and understanding of the subject matter. These concentrations prepare a student to continue graduate studies at the doctoral level and obtain or maintain employment in the chosen field with government agencies, industry or education.

## General Admission Requirements and Placement Examination

At the time of application, a degree aspirant's previous academic work is evaluated. Upon admission to the program any existing deficiencies are identified and recommendations are made to address them by the graduate advisor for the applicant's program concentration of choice. All students are required to pass the qualifying exam(s) for their discipline prior to the completion of 12 hours of graduate degree program work. Placement exam requirements vary depending on the program concentration; therefore, students should consult with their graduate advisor for details. Admission requirements specific to the various concentrations within the Physical Sciences are outlined under the

**Admission Requirements** headings for each concentration (Chemistry, Earth Science, Physics, and Physical Sciences).

## General Degree Requirements

The degree program concentrations require that the student write either a thesis or a research report addressing a selected topic. The thesis option requires successful completion of a minimum of 30 semester hours of approved graduate work. The research report option requires successful completion of a minimum of 32 semester hours of approved graduate work. Both options require successful completion of 15-25 semester hours in the major field(s). Specific course requirements will be determined by the individual candidate in consultation with the candidate's advisor and graduate committee. Due to prerequisites, more than 30 or 32 hours may be required to complete the graduate degree. Per University Graduate School guidelines, a student must earn an overall 3.0 grade point average. A minimum of 60 percent of the credit hours must be in course numbered 700 or higher on the degree plan. For complete graduate requirements, consult the current graduate policies at <http://www.emporia.edu/grad/graduate-policies>.

## Thesis Option

|  | <b>Hours</b>    |
|--|-----------------|
| Thesis and Research<br>(only 6 credit hours of thesis allowed) | 3-8 hours       |
| Major Field courses<br>(see each concentration)                | 15-25 hours     |
| Approved electives   | 5-10 hours      |
| <b>Total (minimum)</b>   | <b>30 hours</b> |

## Research Report Option

|   | <b>Hours</b>    |
|---|-----------------|
| Graduate Research                               | 3-6 hours       |
| Major field courses<br>(see each concentration) | 15-25 hours     |
| Approved electives                              | 5-12 hours      |
| <b>Total (minimum)</b>                          | <b>32 hours</b> |

## Candidacy Requirements

Prior to completion of two semesters of study, the student will identify a research advisor, complete a degree plan, and have a research proposal formally approved by the graduate student's advisor and Department Chair. Once the proposal and plan are completed, the student is admitted to degree candidacy. The research proposal and degree plan are both subject to change after approval as needed by the

student in consult with the research advisor.

### Final Examination

Prior to graduation, the student will submit a satisfactory written thesis or report to the members of the committee and the Department Chair. At a minimum, the research committee will be composed of the research advisor, an additional faculty member of the discipline, and one faculty member outside the discipline. The final examination is the public oral presentation of the research and response to questions posed by the committee. The student must be enrolled in coursework or independent study during the semester of graduation.

### MS Degree, Physical Science, CHEMISTRY CONCENTRATION

The MS concentration in chemistry is designed to prepare graduates for employment in industrial or governmental sectors, for continued graduate work at the doctoral level, or for teaching. Program variations may be tailored to emphasize biochemistry/biotechnology, environmental chemistry or chemistry education in addition to a more traditional chemistry curriculum.

### Admission Requirements

Accepted applicants must have completed a bachelor's degree (BA or BS) from an accredited college or university with a major in chemistry or closely related field. If an applicant does not have a major in chemistry, then course work equivalent to six lecture courses and four laboratory courses in chemistry are expected. Exceptions will be considered on an individual basis, and applicants may be admitted on a provisional status.

### Placement Examinations Requirement

Each student must complete a placement examination for general chemistry (full-year sequence of introductory chemistry) and analytical chemistry. Other placement examinations will be taken as needed before entrance into upper-level chemistry courses.

| <b>Core Requirements</b>  | <b>Total of 8 hours</b> |
|---|-------------------------|
| CH 728 Chemical Literature  | 2 hours                 |
| CH 730 Chemistry Seminar<br>(taken first and last semester)   | 2 hours                 |
| CH 676 Analytical Chemistry<br>(If the student's record includes successful completion of an undergraduate course in quantitative analysis, including laboratory, and the student passes the departmental Analytical Chemistry Placement Examination, the student will be awarded passing credit on the transcript for CH 676.) | 4 hours                 |

Two of the five principal areas of chemistry (analytical, biochemical, inorganic, organic, and physical) must be covered on the degree contract by >700-level content-based courses. Other chemistry courses may be considered for inclusion in a student's program on an individual case basis.

| <b>Thesis option total hours</b>    | <b>30 hours</b> |
|-------------------------------------|-----------------|
| Core requirements (described above) | 8 hours         |
| Research                            | 8 hours         |
| CH 829 Graduate Research            | 3-5 hours       |
| CH 875 Thesis M.S.                  | 3-5 hours       |
| Chemistry electives (see below)     | 8-14 hours      |
| Cognate electives                   | 0-6 hours       |

| <b>Report option total hours</b>      | <b>32 hours</b> |
|---------------------------------------|-----------------|
| Core requirements (described above)   | 8 hours         |
| Research                              | 6 hours         |
| CH 829 Graduate Research (max. 6 hrs) | 6 hours         |
| Chemistry electives (see below)       | 12-18 hours     |
| Cognate electives                     | 0-6 hours       |

### Chemistry electives

|   |           |
|---|-----------|
| CH 500 Topics in Chemistry<br>(*except Survey of Organic) | 1-5 hours |
| CH 506 Environmental Chemistry                            | 3-4 hours |
| CH 508 Industrial Chemistry                               | 1-3 hours |
| CH 578 Water Analysis                                     | 3 hours   |
| CH 627 Intermediate Chemistry                             | 3 hours   |
| CH 745 Nuclear Techniques                                 | 3 hours   |
| CH 660 Biochemistry I                                     | 3 hours   |
| CH 661 Laboratory Methods in Biochemistry                 | 2 hours   |
| CH 662 Biochemistry II                                    | 3 hours   |
| *CH 700 Advanced Topics in Chemistry                      | 1-5 hours |
| CH 720 Physical Chemistry I                               | 3 hours   |
| CH 721 Physical Chemistry Laboratory                      | 2 hours   |
| CH 722 Physical Chemistry II                              | 3 hours   |
| CH 723 Advanced Physical Chemistry<br>Laboratory          | 2 hours   |
| *CH 724 Topics in Physical Chemistry                      | 3 hours   |

|   |           |
|---|-----------|
| CH 725 Advanced Inorganic Chemistry                 | 3 hours   |
| CH 726 Advanced Inorganic Chemistry<br>Laboratory   | 1-3 hours |
| CH 760 Nucleic Acids Biochemistry                   | 3 hours   |
| CH 765 Advanced Biotechnology Laboratory            | 4 hours   |
| *CH 772 Topics in Organic Chemistry                 | 1-3 hours |
| CH 773 Qualitative Organic Analysis                 | 3 hours   |
| *CH 776 Topics in Biochemistry                      | 1-3 hours |
| CH 777 Instrumental Methods of Analysis             | 5 hours   |
| *CH 778 Topics in Analytical Chemistry              | 1-3 hours |
| CH 801 Trends in High School Chemistry<br>Curricula | 3 hours   |
| CH 802 Modern Developments in Chemistry             | 3 hours   |
| *CH 826 Topics in Inorganic Chemistry               | 1-3 hours |
| CH 871 Topics in Advanced Physical<br>Chemistry     | 1-3 hours |

\*The topic in a given semester will be announced in the course schedule. The courses may be repeated for credit when different topics are offered.

Other chemistry courses may be considered for inclusion in a student's program on an individual case basis.

### ***Cognate Electives***

Up to 6 hours of cognate courses (numbered 500 and above) relevant to a student's educational goals may be included in the MS degree plan. Such courses may be selected from those offered in earth science, geology, physics, physical science, biological sciences, mathematics, computer science, education, or other disciplines. The selection of Cognate Electives must be approved by the student's academic advisor, graduate committee, and Chair of the Department prior to enrollment in the cognate course.

### **MS Degree, Physical Science, EARTH SCIENCE CONCENTRATION**

The graduate earth science concentration is designed to provide a broad, flexible, and interdisciplinary background in the earth, environmental, and geological sciences. It is especially well-suited for candidates with career goals in government service, teaching, and/or industry. It can also prepare one for entry into doctoral study.

### **Admission Requirements**

The minimum expected undergraduate preparation in earth science is course work equivalent to the BSE degree with certification in earth/space science, or a BA or BS degree with an earth science, physical geography, geology, or physical science major.

Deficiencies in course background may be addressed concurrent with degree program course work.

### **Application for Admission**

To apply for admission to the earth science concentration, applicants are required to do the following:

- 1) Submit an application for admission; see <http://www.emporia.edu/grad/appinstr.htm> for an electronic application form.
- 2) Provide official transcripts from each undergraduate institution attended. Transcripts must be sent to: Graduate School, Campus Box 4003, Emporia State University, Emporia, Kansas, 66801.
- 3) Provide a statement of relevant background, fields of interest in earth science, and career goals. This should be sent to: Graduate Advisor, Earth Science Department, Campus box 4030, Emporia State University, Emporia, KS, 66801.
- 4) The priority date to submit applications for the upcoming academic year is March 1. Later applications may be considered.
- 5) A faculty committee will review applications and select candidates for admissions. Each candidate will be matched with a prospective faculty advisor.

### **Presentation of Research**

A student is expected to present his/her research at a professional scientific conference or meeting. The presentation may take the form of a poster display, oral lecture, field-trip guide, workshop or other suitable format.

### **MS Degree, Physical Science, PHYSICAL SCIENCE CONCENTRATION**

The physical science concentration is an option for in-service teachers or non-teaching professionals. If an in-service teacher, the physical science concentration is designed to provide graduate work to enhance the chemistry, earth/space science, physics and/or physical science background of a licensed teacher. This concentration can also be preparatory for additional graduate work at the doctoral level in science education. A non-teaching physical science

concentration is designed to provide graduate work to those professionals for whom a broad foundation in the physical sciences is appropriate.

### Admission Requirements

For in-service teachers, the required undergraduate preparation is completion of course work equivalent to the Departments of Physical Sciences undergraduate requirements for secondary teaching licensure in one of chemistry, earth/space science, physics, or closely allied field. For non-teaching professionals, the required preparation is a bachelor's degree with similar preparation from an accredited institution.

### Program Options

Two program options are available for students wishing to pursue this degree concentration.

**Program Option A** is designed for those individuals who want to take the maximum number of hours of course work within the disciplines and who will be full-time graduate students during the academic year.

| <b>Required Courses/Degree Requirements</b>   | <b>Hours</b>    |
|---|-----------------|
| Physical Sciences<br>(CH, ES, GO, PH, or PS)  | 15-25 hours     |
| Nature of the Scientific Enterprise   | 2 hours         |
| CH, PH, ES, PS Thesis hours   | 3-5 hours       |
| <b>OR</b>   |                 |
| CH, PH, ES, PS Research hours   | 3-5 hours       |
| Approved electives, if needed, to bring the total hours to 30 (thesis) or 32 (research report) will be decided by the graduate committee and candidate. |                 |
| <b>Minimum hours required, Thesis Option</b>  | <b>30 hours</b> |
| <b>Minimum hours required, Research Report Option</b>   | <b>32 hours</b> |

**Program Option B** is designed for those individuals who want to do course work within the disciplines and also gain additional competence in science education techniques and curriculum development. This program is specifically designed to be completed during summer sessions, and potentially augmented with academic-year course work.

| <b>Required Courses/Degree Requirements</b> | <b>Hours</b> |
|---|--------------|
| PS 730 Nature of the Scientific Enterprise  | 2 hours      |
| PS 768 Workshop in Physical Science         |              |

|   |           |
|---|-----------|
| Teaching  | 1-3 hours |
| PS 801 Modern Developments in the Physical Sciences | 3 hours   |

| <b>Approved Electives</b>          | <b>Hours</b> |
|------------------------------------|--------------|
| First Physical Science Discipline  | 12 hours     |
| Second Physical Science Discipline | 6 hours      |

| <b>Thesis Option</b>   | <b>Hours</b>    |
|--|-----------------|
| Thesis (offered under several course numbers e.g., CH, ES, PH, and PS) | 3-5 hours       |
| ER 851 Research Design and Writing                                     | 3 hours         |
| <b>Minimum hours required, thesis option</b>                           | <b>30 hours</b> |

| <b>Research Report Option</b>  | <b>Hours</b>    |
|--|-----------------|
| Graduate Research or Research Problem (offered under several course numbers) | 3-6 hours       |
| ER 752 Analysis of Research  | 3 hours         |
| <b>Minimum hours required, Research Report Option</b>                        | <b>32 hours</b> |

### MS Degree, Physical Science, PHYSICS CONCENTRATION

The physics concentration is designed to serve the needs of those planning to advance in a teaching career, enter industrial or governmental work, or continue graduate education at the doctoral level. Students benefit from small classes, a student-oriented faculty, research opportunities, and a flexible curriculum.

### Admission Requirements

For admission to the physics concentration program, the applicant must have completed at least two physics courses for which introductory physics is a prerequisite and must have a demonstrated proficiency in calculus. Students may be admitted on a provisional status, and will be informed upon admission of any specific deficiencies, which must be addressed.

### Required Courses

A master's degree program with a physics concentration requires a minimum of 15 credit hours in physics courses. Advanced-level courses in classical mechanics, electromagnetism, and an advanced laboratory course are required as a common core for all graduate students, e.g., PH 760, Mechanics I and PH 762, Electricity and Magnetism I are required. The advanced laboratory requirement

can be met with any physics laboratory course at the 500-level or above. The degree program will include additional hours of approved electives to meet the minimum number of hours required.

### **Seminar Participation**

Students are expected to attend and participate in scheduled physics seminars during the entire period of full-time graduate study, whether enrolled in such seminars for credit or not. A maximum of two credit hours in seminar may be applied toward the degree.