Science Education

Chair, Department of Teaching and Learning
• John Hosp

Coordinator, Science Education
• Soonhye Park

Undergraduate major: science education (B.S.)
Graduate degrees: M.A.T. in science education; M.S. in science education; Ph.D. in science education
Faculty: http://www.education.uiowa.edu/teach/science/people
Web site: http://www.education.uiowa.edu/teach/science/home

The Science Education Program provides preparation in more than one discipline of science; a consideration of science from a philosophical, historical, and sociological perspective; an introduction to applied science (technology); and an education sequence.

Program planning in science education requires the cooperation and involvement of a variety of University departments and colleges. Most of the program’s requirements are drawn from courses offered by these varied academic units.

Undergraduate Program of Study
• Major in science education (Bachelor of Science)
The major in science education is interdisciplinary. It is intended for students interested in education; it is not intended to prepare students for advanced study in one area of science. When graduates of the Science Education Program elect to pursue graduate study in a specific area of science, they often must complete additional coursework in that discipline after they are admitted to the Graduate College.

Students majoring in science education earn a Bachelor of Science degree, which is awarded by the College of Liberal Arts and Sciences.

SPECIAL RULES
The Science Education Program may involve many faculty advisors and more than one college or department. Consequently, the following special rules apply to science education students.

At least 10 s.h. of graded credit in science must be earned at the University of Iowa.

No credit from the CLEP Natural Science General Examination may be applied toward the major in science education.

Courses for the major may not be taken pass/nonpass. Grades from all courses applied toward the science education major are used in computing a student’s grade-point average in the major, both at the University of Iowa and overall.

Since mathematics forms an integral part of so many aspects of modern science, all-science emphasis area education students are urged to complete appropriate advanced courses in both pure and applied mathematics (including statistics and computer science) so that they may be qualified to do graduate work and quantitative research later.

Bachelor of Science
The Bachelor of Science with a major in science education requires a minimum of 120 s.h., including at least 48-50 s.h. of work for the major. Students must maintain a g.p.a. of at least 2.70 in all courses for the major and in all UI courses for the major. They also must complete the College of Liberal Arts and Sciences General Education Program.

The science education curriculum includes courses offered by science departments in the College of Liberal Arts and Sciences, science applications courses, and courses in the history, philosophy, and sociology of science. Students who complete the major gain:

• knowledge in two or more areas of science;
• a specified proficiency in mathematics as a tool of science (with more mathematics study required for the physical science emphases than for the biological ones);
• a view of science from a historical/philosophical/cultural perspective; and
• experience with the application of scientific knowledge.

The major offers five emphasis areas: all-science, biology, chemistry, earth science, and physics.

The all-science emphasis area is open only to students who will earn teacher licensure and would like equal preparation in biology, chemistry, earth science, and physics. Students who choose the all-science emphasis area do not choose a secondary emphasis area. They must complete all requirements for teacher licensure in order to graduate in the all-science emphasis area.

Students who do not choose the all-science emphasis area may elect whether or not to earn teacher licensure. They choose a primary and a secondary emphasis area from biology, chemistry, earth science, and physics, acquiring depth in the primary emphasis area equivalent to six semesters of sequential study and preparation in the secondary area equivalent to four semesters of sequential study.

All science education students must complete the requirements for their emphasis area(s) plus the broad field science block. Those who wish to earn teacher licensure also must complete the College of Education’s Teacher Education Program (TEP), including the 48 s.h. professional education sequence; see “B.S. with Teacher Licensure” later in this section.

The major in science education requires the following course work.

ALL-SCIENCE EMPHASIS AREA
Students who choose the all-science emphasis area do not choose a secondary emphasis area. They complete a minimum of 48 s.h. for the major, including at least 36 s.h. in the following course work (at least 9 s.h. in each of the four science disciplines—biology, chemistry, earth science, and physics), plus 12 s.h. in the broad field science block. They also must complete all requirements for teacher licensure (see “B.S. with Teacher Licensure” below).

Biology—at least 9 s.h. from these:
BIOL:1411 Foundations of Biology 4 s.h.
BIOL:1412 Diversity of Form and Function 4 s.h.
BIOL:2211 Genes, Genomes, and the Human Condition 3 s.h.
BIOL:2673 Ecology 3-4 s.h.
BIOL:3172 Evolution 4 s.h.
HHP:3500 Human Physiology 3 s.h.
Chemistry—at least 9 s.h. from these:
CHEM:1110 Principles of Chemistry I 4 s.h.
CHEM:1120 Principles of Chemistry II 4 s.h.
CHEM:2021 Basic Measurements 3 s.h.
CHEM:2210 Organic Chemistry I 3 s.h.
CHEM:2220 Organic Chemistry II 3 s.h.
Earth science—at least 9 s.h. from these:
EES:1030 Introduction to Earth Science 3-4 s.h.
EES:1040 Evolution and the History of Life 3-4 s.h.
EES:1050 Introduction to Geology 4 s.h.
EES:1080 Introduction to Environmental Science 3-4 s.h.
EES:2831 Geologic Field Methods 3 s.h.
EES:3070 Marine Ecosystems and Conservation 3 s.h.
Physics—at least 9 s.h. chosen as follows.
At least one of these:
ASTR:1070 Stars, Galaxies, and the Universe 3-4 s.h.
PHYS:1200 Physics of Everyday Experience 3 s.h.
No more than one of these:
PHYS:1511 College Physics I 4 s.h.
PHYS:1611 Introductory Physics I 4 s.h.
PHYS:1701 Physics I 4 s.h.
No more than one of these:
PHYS:1512 College Physics II 4 s.h.
PHYS:1612 Introductory Physics II 3-4 s.h.
PHYS:1702 Physics II 4 s.h.
Additional requirements for the major:
Course work listed under "Broad Field Science Block" below

**BIOLOGY EMPHASIS AREA**

Students who choose biology as their primary emphasis area complete a minimum of 50 s.h. for the major, including 23-25 s.h. in the following biology course work plus at least 15 s.h. in a secondary emphasis area (chemistry, earth science, or physics) and 12 s.h. in the broad field science block. With their advisor's permission, students may include a science applications course in their secondary emphasis area.

This sequence:

BIOL:1411-BIOL:1412 Foundations of Biology - Diversity of Form and Function 8 s.h.

One of these:

BIOL:1311 Human Genetics in the Twenty-First Century 3 s.h.
BIOL:2512 Fundamental Genetics 4 s.h.
One of these:

BIOL:2374 Biogeography 3 s.h.
BIOL:2673 Ecology 3 s.h.
One of these:

BIOL:1370 Understanding Evolution 3 s.h.
BIOL:3172 Evolution 4 s.h.
One of these:

BIOL:3343 Animal Physiology 3 s.h.
HHP:3500 Human Physiology 3 s.h.
One of these:

BIOC:3110 Biochemistry 3 s.h.
BIOL:2723 Cell Biology 3 s.h.
BIOL:3233 Introduction to Developmental Biology 3 s.h.
BIOL:3363 Plant Developmental Biology 3 s.h.

**CHEMISTRY EMPHASIS AREA**

Students who choose chemistry as their primary emphasis area complete a minimum of 49 s.h. for the major, including 22 s.h. in the following chemistry course work plus at least 15 s.h. in a secondary emphasis area (biology, earth science, or physics) and 12 s.h. in the broad field science block. With their advisor's permission, students may include a science applications course in their secondary emphasis area.

All of these:

CHEM:1110 & CHEM:1120 Principles of Chemistry I-II 8 s.h.
CHEM:2210 Organic Chemistry I 3 s.h.
CHEM:2220 Organic Chemistry II 3 s.h.
CHEM:2410 Organic Chemistry Laboratory 3 s.h.
CHEM:3250 Inorganic Chemistry (spring) 2 s.h.
One of these:

BIOC:3110 Biochemistry 3 s.h.
CHEM:3110 Analytical Chemistry I 3 s.h.
CHEM:4431 Physical Chemistry I 3 s.h.

Additional requirements for the major:

Course work in a secondary emphasis area (biology, earth science, or physics) 15 s.h.
Course work listed under "Broad Field Science Block" below 12 s.h.

**EARTH SCIENCE EMPHASIS AREA**

Students who choose earth science as their primary emphasis area complete a minimum of 48 s.h. for the major, including at least 21 s.h. in the following earth science course work plus at least 15 s.h. in a secondary emphasis area (biology, earth science, or physics) and 12 s.h. in the broad field science block. With their advisor's permission, students may include a science applications course in their secondary emphasis area.

All of these:

CHEM:1100 Principles of Chemistry I 3 s.h.
CHEM:1120 Principles of Chemistry II 4 s.h.
CHEM:2021 Basic Measurements 3 s.h.
CHEM:2210 Organic Chemistry I 3 s.h.
CHEM:2220 Organic Chemistry II 3 s.h.
CHEM:2410 Organic Chemistry Laboratory 3 s.h.
CHEM:3250 Inorganic Chemistry (spring) 2 s.h.
One of these:

BIOC:3110 Biochemistry 3 s.h.
CHEM:3110 Analytical Chemistry I 3 s.h.
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Additional requirements for the major:

Course work in a secondary emphasis area (biology, earth science, or physics) 15 s.h.
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**BIOLOGY EMPHASIS AREA**

Students who choose biology as their primary emphasis area complete a minimum of 50 s.h. for the major, including 23-25 s.h. in the following biology course work plus at least 15 s.h. in a secondary emphasis area (chemistry, earth science, or physics) and 12 s.h. in the broad field science block. With their advisor's permission, students may include a science applications course in their secondary emphasis area.

This sequence:

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One of these:

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One of these:

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BIOL:2673 Ecology 3 s.h.
One of these:

BIOL:1370 Understanding Evolution 3 s.h.
BIOL:3172 Evolution 4 s.h.
One of these:

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Course work listed under "Broad Field Science Block" below 12 s.h.

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Students who choose earth science as their primary emphasis area complete a minimum of 48 s.h. for the major, including at least 21 s.h. in the following earth science course work plus at least 15 s.h. in a secondary emphasis area (biology, earth science, or physics) and 12 s.h. in the broad field science block. With their advisor's permission, students may include a science applications course in their secondary emphasis area.

All of these:

CHEM:1100 Principles of Chemistry I 3 s.h.
CHEM:1120 Principles of Chemistry II 4 s.h.
CHEM:2021 Basic Measurements 3 s.h.
CHEM:2210 Organic Chemistry I 3 s.h.
CHEM:2220 Organic Chemistry II 3 s.h.
CHEM:2410 Organic Chemistry Laboratory 3 s.h.
CHEM:3250 Inorganic Chemistry (spring) 2 s.h.
One of these:

BIOC:3110 Biochemistry 3 s.h.
CHEM:3110 Analytical Chemistry I 3 s.h.
CHEM:4431 Physical Chemistry I 3 s.h.

Additional requirements for the major:

Course work in a secondary emphasis area (biology, earth science, or physics) 15 s.h.
Course work listed under "Broad Field Science Block" below 12 s.h.
emphasis area (biology, chemistry, or physics) and 12 s.h. in the broad field science block. With their advisor's permission, students may include a science applications course in their secondary emphasis area.

Both of these:

- EES:1040 Evolution and the History of Life 4 s.h.
- EES:1080 Introduction to Environmental Science 4 s.h.

One of these:

- EES:1030 Introduction to Earth Science 3-4 s.h.
- EES:1050 Introduction to Geology 4 s.h.

One of these:

- EES:2831 Geologic Field Methods 3 s.h.
- EES:3000 Geologic Training Assignment 1-3 s.h.
- EES:3300 Sedimentary Geology 4 s.h.
- EES:3840 Structural Geology 4 s.h.

One of these:

- EES:3020 Earth Surface Processes 3 s.h.
- EES:3210 Principles of Paleontology 3 s.h.
- EES:3360 Soil Genesis and Geomorphology 3 s.h.

One of these:

- EES:1290 Energy and the Environment 3 s.h.
- GEOG:1050 Foundations of GIS 3 s.h.
- GEOG:4010 Field Methods in Physical Geography 3 s.h.

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Additional requirements for the major:

- Course work in a secondary emphasis area (biology, chemistry, or earth science) 15 s.h.
- Course work listed under "Broad Field Science Block" below 12 s.h.

**BROAD FIELD SCIENCE BLOCK**

All science education students must complete the following broad field science block course work (12 s.h.) in addition to the requirements for their emphasis area(s).

This course:

- SIED:4135 The Nature of Science 4 s.h.

One of these:

- SIED:4102 Societal and Educational Applications of Earth Science and Environmental 4 s.h.
- SIED:4103 Societal and Educational Applications of Biological Sciences 4 s.h.

One of these:

- SIED:4105 Societal and Educational Applications of Physical Sciences 4 s.h.
- SIED:4106 Societal and Educational Applications of Chemical Concepts 4 s.h.

**B.S. with Teacher Licensure**

In order to earn licensure to teach in elementary and/or secondary schools, students must satisfy all requirements for the science education major and for graduation and must complete the College of Education’s Teacher Education Program (TEP).

Students must satisfy all degree requirements and complete Teacher Education Program licensure before degree conferral.

In order to be considered for admission to the TEP, students must have completed a minimum of 30 s.h. of course work with a cumulative g.p.a. of at least 3.00. Admission decisions are based on grade-point averages in science courses and other criteria relevant to teaching. A limited number of applicants are accepted to the TEP, so having the required grade-point average does not ensure admission. Contact the Office of Education Services for information about applying to the TEP.

The TEP requires the following professional education courses, which total a minimum of 48 s.h.
EDTL:3002 Technology in the Classroom 2-3 s.h.
EDTL:3071 Secondary Classroom Management 2 s.h.
EDTL:3090 Orientation to Secondary Education 1 s.h.
EDTL:3095 Teaching Reading in Secondary Content Areas 1 s.h.
EDTL:4900 Foundations of Special Education 3 s.h.
EPLS:3000 Foundations of Education 3 s.h.
EPLS:4180 Human Relations for the Classroom Teacher 3 s.h.
PSQF:1075 Educational Psychology and Measurement 3 s.h.
These taken in sequence:
EDTL:4751 Science Teaching and Practice with Early Learners 2 s.h.
EDTL:4752 Methods of Teaching Science 3 s.h.
EDTL:4753 Instructional Issues in Teaching Science 3 s.h.
EDTL:4757 Assessment in the Science Classroom 2 s.h.
EDTL:4779 Secondary School Science Practicum (taken with EDTL:4753) 2 s.h.
These three taken concurrently:
EDTL:4087 Seminar: Curriculum and Student Teaching (section 91) 3 s.h.
EDTL:4091 Observation and Laboratory Practice in the Secondary School 6 s.h.
EDTL:4092 Observation and Laboratory Practice in the Secondary School 6 s.h.
And:
One college-level math course, excluding MATH:0100, MATH:0300, and MATH:1005

Four-Year Graduation Plan
The Four-Year Graduation Plan is not available to students majoring in science education.

Honors in the Major
The Science Education Program offers outstanding students the opportunity to graduate with honors in the major. Honors students in science education must maintain a cumulative University of Iowa g.p.a. of at least 3.33 and fulfill other requirements; contact the Science Education Program for more information about graduating with honors in the science education major.

In addition to honors in their majors, undergraduate students have a variety of opportunities for honors study and activities through membership in the University of Iowa Honors Program; visit Honors at Iowa to learn about the University’s honors program.

Graduate Programs of Study
• Master of Arts in Teaching in science education
• Master of Science in science education
• Doctor of Philosophy in science education

For information about graduate programs in science education, see Teaching and Learning (College of Education) in the Catalog. The M.A.T., M.S., and Ph.D.

are described under "Graduate Programs: Secondary Education."

Research
Each faculty member in science education is responsible for one or more areas of research. Major interests include studies of effective teaching and learning, science through writing, philosophy and sociology of science, individualized learning, social issues in science and technology, curriculum planning and development, professional development, intellectual development related to teaching and learning science, studies of effective use of hands-on activities, and evaluation and assessment of science instruction and programs.

Programs and Projects
A wide range of funded programs provides ample opportunity for students to be involved in innovative development and research in science education.

Science education faculty members collaborate on a number of international research projects in many countries. Activities include faculty exchanges and cross-national studies.

International students enrich the opportunities for graduate studies in Science Education. New international collaborative efforts are under way each year.

Courses
SIED:3001 Introduction to Museum Studies 3 s.h.
Overview of museum history, function, philosophy, collection, and curatorial practices; governance and funding issues; exhibition evaluation and audience studies; examples from Museum of Art, Museum of Natural History, Old Capitol Museum, and Medical Museum.

SIED:4102 Societal and Educational Applications of Earth Science and Environmental alb. Major ideas and principles of earth and environmental sciences; emphasis on common applications in today’s world.

SIED:4103 Societal and Educational Applications of Biological Sciences alb. Basic conceptual themes of biology, how they have been derived; emphasis on a current social issue related to biology.

SIED:4105 Societal and Educational Applications of Physical Sciences alb. Major ideas of physics and how they have been derived; emphasis on how such ideas affect modern society.

SIED:4106 Societal and Educational Applications of Chemical Concepts alb. Principles of chemistry as applied in industry, communication, daily living.

SIED:4115 Directed Study
SIED:4135 The Nature of Science 3-4 s.h.
Ideas on understanding and ways of thinking that are essential in a world shaped by science, technology, engineering, and mathematics; focus on increasing science literacy by examining the nature of science; comparison of characteristics specific to individual science disciplines; identification of great episodes and debates in history of science and habits that are essential for science literacy; scope and sequence of content and process skills for K-12 curriculum, instruction, and assessment.