

# Science Education

[www.science-ed.uni.edu](http://www.science-ed.uni.edu)

Science Education is an interdepartment and intercollegiate entity within the College of Humanities, Arts, and Sciences. There is no science education department as such. Some science teaching majors are offered under the jurisdiction and general supervision of the Dean of the College of Humanities, Arts and Sciences. The responsibility for programs and courses in science education is delegated to the science education faculty under its chairperson. Members of the science education faculty hold their primary appointments in the various science departments in the College of Humanities, Arts and Sciences and in the Department of Teaching in the College of Education.

The following undergraduate and graduate programs are offered in science education. Specific requirements for these programs are listed within this Science Education section in the following order:

## Undergraduate Majors (B.A.)

- Comprehensive Secondary Science-Teaching
- Middle Level Science-Teaching (Dual)

## Minor

- Basic Science (K-8)-Teaching
- STEM Education Minor

## Graduate Major (M.A.)

- Science Education

## Bachelor of Arts Degree Programs

### Comprehensive Secondary Science-Teaching (*Extended Program*)

The Comprehensive Secondary Science Teaching major requires a minimum of 137 total hours to graduate. This total includes Liberal Arts Core requirements, the Professional Education Requirements, and the following specified major requirements to complete the minimum of 137 hours. Because of the number of courses required for this major and course sequencing, it cannot be completed in eight semesters of normal work. It will require a longer time or additional work during summers.

This major is intended for students who wish to teach at the secondary level in all areas of science (biology, chemistry and biochemistry, earth science, and physics). The program will lead to Iowa Department of Education endorsement in Basic Science (5-12), All Science (5-12), Biology (5-12), Chemistry (5-12), Earth Science (5-12), and Physics (5-12).

### Required

Science Education:		
SCI ED 3300/5300 (820:190g)	Orientation to Science Teaching (Teaching)	4
SCI ED 4700/5700 (820:193g)	Methods for Teaching Physical Science	3

Biology:

BIOL 2051 (840:051)	General Biology: Organismal Diversity	4
BIOL 2052 (840:052)	General Biology: Cell Structure and Function	4
BIOL 3100 (840:100)	Evolution, Ecology and the Nature of Science	3
BIOL 3140 (840:140)	Genetics	4
BIOL 4193/5193 (840:193g)	Methods for Teaching Life Science	3
Chemistry and Biochemistry:		
CHEM 1110 (860:044)	General Chemistry I	4
CHEM 1120 (860:048)	General Chemistry II *	4
Earth Science:		
EARTHSCI 1300 (870:031)	Introduction to Geology	4
EARTHSCI 1320 (870:035)	Earth History	4
Physics:		
PHYSICS 1511 (880:054)	General Physics I	4
PHYSICS 1512 (880:056)	General Physics II **	4
<b>Electives from the following:</b>		
Chemistry and Biochemistry:		7
CHEM 2040	Applied Organic and Biochemistry	
or CHEM 2210 (860:120)	Organic Chemistry I	
plus one 2000-level course ^		
Earth Science:		
EARTHSCI 1100 (870:010)	Astronomy ***	4
EARTHSCI 1200 (870:021)	Elements of Weather	3
EARTHSCI 1210 (870:022)	Elements of Weather Laboratory	1
Physics:		
any 2000-level course		7
Teaching		
TEACHING 3129	Secondary and Special-Area Classroom Management	1
<b>Total Hours</b>		<b>72</b>

\* Students with excellent preparation in chemistry may substitute CHEM 1130 (860:070) plus 3 hours of additional credit hours in chemistry electives for CHEM 1110 (860:044) and CHEM 1120 (860:048).

\*\* Students with excellent preparation in physics and calculus may substitute PHYSICS 1701 (880:130) and PHYSICS 1702 (880:131) for *PHYSICS 1511 (880:054)* and PHYSICS 1512 (880:056)

\*\*\* *EARTHSCI 1100 (870:010)* must be taken for four semester hours of credit.

For completion of this major the grade point average in each of the four science disciplines must be a minimum of 2.00, with a 2.50 GPA in the major as a whole.

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Elective courses must be ones that count toward the major in the discipline or be approved for this use by the department offering the course.

### Notes:

1. Students with sufficient high school preparation may be allowed to omit some introductory courses and substitute other courses from the same department.
2. The mathematics prerequisite for one or more of the above courses is a working knowledge of algebra and trigonometry or MATH 1140 (800:046).

## Middle Level Science-Teaching (Dual)

The Middle Level Science Teaching (Dual) major requires a minimum of 133-136 total hours to graduate. This total includes Liberal Arts Core requirements, the Professional Education Requirements, and the following specified major requirements to complete the minimum of 133-136 hours.

Students who complete this major must also complete the Middle Level Education Dual Major – Teaching (see Department of Curriculum and Instruction). This major is for students who wish to teach at the middle school level. Students will complete subject area concentrations in science and up to three other subject area concentrations including Language Arts, Mathematics, and/or Social Studies. This major fulfills the following endorsements: Basic Science (5-12), Middle School Science (5-8) and one other Middle School subject (5-8) including Language Arts, Mathematics, or Social Studies.

### Required

Science Education:		
SCI ED 3300/5300 (820:190g)	Orientation to Science Teaching	4
and one of the following methods courses:		
SCI ED 4700/5700 (820:193g)	Methods for Teaching Physical Science	3
or BIOL 4193/5193 (840:193g)	Methods for Teaching Life Science	
Biology:		
BIOL 2051 (840:051)	General Biology: Organismal Diversity	4
BIOL 2052 (840:052)	General Biology: Cell Structure and Function	4
Chemistry and Biochemistry:		
CHEM 1110 (860:044)	General Chemistry I	4
CHEM 1120 (860:048)	General Chemistry II *	4
Earth Science:		
EARTHSCI 1200 (870:021)	Elements of Weather	3
EARTHSCI 1210 (870:022)	Elements of Weather Laboratory	1
EARTHSCI 1300 (870:031)	Introduction to Geology	4
Physics:		
PHYSICS 1511 (880:054)	General Physics I	4
PHYSICS 1512 (880:056)	General Physics II	4
Total Hours		39

\* Students with excellent preparation in chemistry may substitute CHEM 1130 (860:070) plus 3 hours of additional credit hours in chemistry electives for *CHEM 1110 (860:044)* and CHEM 1120 (860:048).

For completion of this major the grade point average in each of the four science disciplines must be a minimum of 2.00, with a 2.50 GPA in the major as a whole.

### Notes:

The mathematics prerequisite for one or more of the above courses is a working knowledge of algebra and trigonometry or MATH 1130 (800:044) or MATH 1140 (800:046) .

## Minor

### Basic Science Minor (K-8)-Teaching

For those pursuing K-6 general classroom teacher licensure with an endorsement in Basic Science (K-8).

### Required

Science and Science Education:		
SCI ED 1100 (820:033)	Inquiry into Earth and Space Science	4
SCI ED 1200 (820:032)	Inquiry into Life Science	4
SCI ED 1300 (820:031)	Inquiry into Physical Science	4
SCI ED 3100/5100 (820:130g)	Integrating Science, Technology, Engineering, and Mathematics in the Elementary Classroom	2
SCI ED 2300 (820:181)	Investigations in Physical Science	4
Biology:		
BIOL 3181 (840:181)	Investigations in Life Science	4
Earth Science:		
EARTHSCI 3500 (870:181)	Investigations in Earth and Space Sciences	4
Electives		
Chemistry and Biochemistry, or Physics:		4
Select one from the following:		
CHEM 1010 (860:010)	Principles of Chemistry	
PHYSICS 1400 (880:011)	Conceptual Physics	
Total Hours		30

## STEM Education Minor

The STEM Education minor is designed to prepare students for careers as integrated science, technology, engineering, and mathematics teachers. This minor is especially appropriate for students planning to earn certification as an elementary or secondary educator and teach elementary and middle level math, science, and/or integrated STEM courses. This minor qualifies students for either the Iowa Grades K-8 STEM Teaching endorsement (for those holding the teacher-elementary classroom endorsement) or the Iowa Grades 5-8 STEM endorsement (for those holding a required first endorsement in mathematics, science, or technology education).

The STEM Education minor requires a minimum of 33 total credit hours to complete. This total includes courses that meet either Liberal

Arts Core requirements or specified major requirements. **Options that best fit those seeking an elementary education degree are designated with a \*.** **Options that best fit those seeking a secondary education degree are designated with a ^.** **Courses that are required by both elementary and secondary teaching majors are designated with a \*^.**

**Group 1 - STEM Education Minor Required Core Classes 11-13**

**Computer Science**

CS 1140 Programming Environments for Secondary Education ^

or

CS 1150 Programming Environments for Elementary Education \*

**Mathematics**

MATH 3213/5213 (800:113g) Topics in Mathematics for Grades K-8 \*

or

MATH 3313 Topics in Secondary Mathematics ^

**Science Education**

SCI ED 3100/5100 (820:130g) Integrating Science, Technology, Engineering, and Mathematics in the Elementary Classroom \*

or

SCI ED 3300/5300 (820:190g) Orientation to Science Teaching ^

**Technology**

TECH 1019 (330:019) Introduction to Technology and Engineering Education \*^

**Studies in STEM Experiences**

4186/5186 Studies in STEM Experiences\*^ with department options of CS 4186/5186, MATH 4186/5186, SCI ED 4186/5186, or TECH 4186/5186

**Group 2 - Mathematics Content Electives<sup>1</sup> 6-7**

MATH 1420 (800:060) Calculus I ^

MATH 1421 (800:061) Calculus II ^

MATH 2204 Mathematical Reasoning for Elementary Teachers II \*

MATH 3204 Mathematical Reasoning for Elementary Teachers III \*

MATH 3211 (800:111g) Introduction to Algebraic Thinking for Elementary Teachers \*

MATH 3212/5212 (800:112g) Introduction to Geometry and Measurement for Elementary Teachers \*

MATH 3214/5214 (800:114g) Problem Solving in Mathematics for Elementary Teachers \*

MATH 3215 (800:192) Mathematics for Elementary Students with Special Needs \*

MATH 2500 (800:076) Linear Algebra for Applications ^

MATH 3530/5530 (800:143g) Combinatorics ^

MATH 3600/5600 (800:166g) Euclidean Geometry ^

MATH 3610/5610 (800:165g) Modern Geometries ^

MATH 3751 (800:173) Probability and Statistics ^

STAT 1772 (800:072) Introduction to Statistical Methods ^

or STAT 1774 (800:064) Introductory Statistics for Life Sciences

**Group 3 - Science Content Electives<sup>2</sup> 12**

BIOL 2051 (840:051) General Biology: Organismal Diversity ^

BIOL 2052 (840:052) General Biology: Cell Structure and Function ^

BIOL 3100 (840:100) Evolution, Ecology and the Nature of Science ^

BIOL 3181 (840:181) Investigations in Life Science \*

CHEM 1020 (860:020) Chemical Technology ^

CHEM 1110 (860:044) General Chemistry I ^

CHEM 1130 (860:070) General Chemistry I-II ^

EARTHSCI 1300 (870:031) Introduction to Geology ^

EARTHSCI 1320 (870:035) Earth History ^

EARTHSCI 3500 (870:181) Investigations in Earth and Space Sciences \*

PHYSICS 1511 (880:054) General Physics I ^

PHYSICS 1701 (880:130) Physics I for Science and Engineering ^

SCI ED 2300 (820:181) Investigations in Physical Science \*<sup>3</sup>

**Group 4 - Technology Electives 3**

TECH 1006 Project Lead The Way: Introduction to Engineering Design ^

TECH 3010 Project Lead The Way: Principles of Engineering ^

TECH 3102 (330:102) Living in Our Techno-Social World \*

**Total Hours 33**

Notes:

<sup>1</sup> Students must earn a minimum of 12 credit hours in Mathematics to earn the endorsement, including MATH 3213/5213 (800:113g) or MATH 3313 from Group 1. Additionally, the Computer Science courses, CS 1140 or CS 1150, from Group 1 count toward fulfilling the 12 hour Mathematics requirement.

<sup>2</sup> Science content courses must include a minimum of 1 Biology, 1 Earth Science, and 1 Physics or Chemistry course.

<sup>3</sup> SCI ED 2300 (820:181) is counted as fulfilling the Chemistry or Physics requirement.

## Master of Arts Degree Program

### Major in Science Education

Students interested in this program must submit a completed Application for Admission to Graduate Study and should refer to their MyUNIverse Student Center To-Do list or contact Science Education Chair. Graduate information and application for graduate admission can be found at [www.grad.uni.edu/admission](http://www.grad.uni.edu/admission).

The Graduate Record Examination (General Test) **is not** required for admission to the program.

This major requires as a prerequisite a bachelor's degree (teaching degree preferred) with a major or minor/emphasis in Science or in a specific science discipline. Teacher licensure is a prerequisite for completing the program approval process for this major.

**Only graduate courses (course numbers 5000 or above) will apply to a graduate degree, even if the undergraduate course number (4999 or less) is listed. No exceptions will be made.**

This major is available on the **thesis** and **non-thesis** options. A **minimum of 30 semester hours**, including 6 hours of SCI ED 6299 (820:299) for thesis research and writing, is required for the **thesis** option; a **minimum of 32 semester hours**, including completion and in some cases public presentation of a creative component, is required for the **non-thesis** option. **A minimum of 17 hours of 200/6000-level course work is required for the thesis option. A minimum of 14 hours of 200/6000-level course work is required for the non-thesis option.**

#### Required

Measurement and Research:		
MEASRES 6205 (250:205)	Educational Research	3
or SCI ED 6500	Research Methods in Science Education	
Science and Science Education:		
SCI ED 6600 (820:294)	Developing Science Curricula	2
SCI ED 6700 (820:200)	The History, Philosophy, and Nature of Science	2
SCI ED 6800 (820:213)	Teaching-Learning Models in Science Education	2
SCI ED 6900 (820:290)	Trends and Issues in Science Education	2
Thesis or non-thesis option		19 or 21
Total hours thesis option		30
Total hours non-thesis option		32

#### Thesis Option

Research:		
SCI ED 6299 (820:299)	Research	6
Science content courses		8
Electives from education or science education		5
Total Hours		19

#### Non-Thesis Option

Research:		
SCI ED 6299 (820:299)	Research	3
Science content courses		11
Electives from education or science education		7
Total Hours		21

### Earth Science Education Emphasis

The Earth Science Education emphasis differs from the Science Education major in that it provides the option of taking either SCI ED 6299 (820:299) or EARTHSCI 6299 (870:299) and also requires 8 hours of graduate credit in Earth Science and a total of 36 hours in Earth Science in combined graduate and undergraduate programs.

#### Required

Measurement and Research:		
MEASRES 6205 (250:205)	Educational Research	3
or SCI ED 6500	Research Methods in Science Education	
Science Education:		
SCI ED 6600 (820:294)	Developing Science Curricula	2
SCI ED 6700 (820:200)	The History, Philosophy, and Nature of Science	2
SCI ED 6800 (820:213)	Teaching-Learning Models in Science Education	2
SCI ED 6900 (820:290)	Trends and Issues in Science Education	2
Thesis or non-thesis option		19 or 21
Total hours thesis option		30
Total hours non-thesis option		32

#### Thesis Option

Research:		
SCI ED 6299 (820:299)	Research	6
or EARTHSCI 6299 (870:299)	Research	
Earth Science content		8
Electives from education or science education		5
Total Hours		19

#### Non-Thesis Option

Research:		
SCI ED 6299 (820:299)	Research	3
or EARTHSCI 6299 (870:299)	Research	
Science content with at least 8 hours of Earth Science		11
Electives from education or science education		7
Total Hours		21

### Physics Education Emphasis

The Physics Education emphasis differs from the Science Education major in that it provides the option of taking either SCI ED 6299

(820:299) or PHYSICS 6299 (880:299) and also requires 8 hours of graduate credit in physics and a total of 36 hours in physics in combined graduate and undergraduate programs.

**Required**

Measurement and Research:		
MEASRES 6205 (250:205) or SCI ED 6500	Educational Research Research Methods in Science Education	3
Science Education:		
SCI ED 6600 (820:294)	Developing Science Curricula	2
SCI ED 6700 (820:200)	The History, Philosophy, and Nature of Science	2
SCI ED 6800 (820:213)	Teaching-Learning Models in Science Education	2
SCI ED 6900 (820:290)	Trends and Issues in Science Education	2
Thesis or non-thesis option		19 or 21
Total hours thesis option		30
Total hours non-thesis option		32

**Thesis Option**

Research:		
SCI ED 6299 (820:299) or PHYSICS 6299 (880:299)	Research Research	6
Physics content		8
Electives from education or science education		5
Total Hours		19

**Non-Thesis Option**

Research:		
SCI ED 6299 (820:299) or PHYSICS 6299 (880:299)	Research Research	3
Science content with at least 8 hours of Physics		11
Electives from education or science education		7
Total Hours		21

Inquiries for additional information concerning this major, including assignment of an advisor and advisory committee, should be made to the Science Education Graduate Program Coordinator.

**Courses**

**SCI ED 1100 (820:033). Inquiry into Earth and Space Science — 4 hrs.**

Inquiry-oriented introduction to fundamental concepts and processes in meteorology, astronomy, and geology using active investigation. Integrated lecture/lab for 5 periods. For Elementary Education and Early Childhood majors only. Prerequisite(s): student must have satisfied university entrance requirements in English and Mathematics. (Fall and Spring)

**SCI ED 1200 (820:032). Inquiry into Life Science — 4 hrs.**

Inquiry-oriented introduction to fundamental concepts and processes in life science that includes ecology, evolution, cell biology, and human body systems. Integrated lecture/lab for 5 periods. For Elementary Education and Early Childhood Education majors only.

Prerequisite(s): student must have satisfied university entrance requirements in English and Mathematics. (Fall and Spring)

**SCI ED 1300 (820:031). Inquiry into Physical Science — 4 hrs.**

Inquiry-oriented introduction to fundamental concepts and processes in physics and chemistry that includes energy, force and motion, and the nature of matter. Integrated lecture/lab for 5 periods. For Elementary Education and Early Childhood Education majors only.

Prerequisite(s): student must have satisfied university entrance requirements in English and Mathematics. (Fall and Spring)

**SCI ED 1600 (820:095). Exploring Science Teaching — 1 hr.**

Exploration of science teaching with well-qualified teacher speakers, classroom discussions about innovative teaching, student learning, and teaching as a profession. Brief field experience included. Discussion, 1 period. Prerequisite(s): consent of instructor. (Fall and Spring)

**SCI ED 2300 (820:181). Investigations in Physical Science — 4 hrs.**

Introduction to significant physical science concepts and models of effective teaching related to elementary school physical science. Continuation of concepts and processes in physics and chemistry that include electricity, magnetism, light, sound, solutions, acids and bases, changes in matter, and chemical bonding. Prerequisite(s): SCI ED 1300 (820:031). (Even Springs)

**SCI ED 3100/5100 (820:130g). Integrating Science, Technology, Engineering, and Mathematics in the Elementary Classroom — 2 hrs.**

Focuses on integrating science, technology, engineering principles, and mathematics using both modeling and an inquiry approach. Engineering and scientific practices drive both the instructional planning, and inquiry-oriented curricula and assessment. The practice of engineering, along with the difference between science and engineering is addressed. Prerequisite(s): junior standing; two courses from SCI ED 1200 (820:032), SCI ED 1300 (820:031), and SCI ED 1100 (820:033) OR approval of the instructor. (Even Falls)

**SCI ED 3300/5300 (820:190g). Orientation to Science Teaching — 4 hrs.**

Introduction to inquiry science teaching including instructional planning and strategies, assessment, and classroom management. Highlights issues and trends in science teaching. Discussion, 3 periods. Field experiences in secondary school science classroom. Prerequisite(s): TEACHING 3128; a major or minor in a science area; junior standing. (Fall and Spring)

**SCI ED 3500/5500 (820:113g). Techniques for Science Teachers — 1-3 hrs.**

Topics selected to assist science teachers in improving their teaching. These may include teaching or assessment strategies, laboratory techniques, specific science concepts, or examples of new curricula. Topic listed in Schedule of Classes. Application to major requires advisor approval. May be repeated up to 7 hours. Prerequisite(s): junior standing; consent of instructor. (Variable)

**SCI ED 4198 (820:198). Independent Study. (Variable)**

**SCI ED 4700/5700 (820:193g). Methods for Teaching Physical Science — 3 hrs.**

Teaching approaches, instructional and assessment strategies, curricular and laboratory materials, and issues in grades 5-12 physical science, physics, chemistry, and earth science. Field experiences in secondary school science classrooms. Discussion, 3 periods. Prerequisite(s): TEACHING 3128; EDPSYCH 3148 (200:148);

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MEASRES 3150 (250:150); SCI ED 3300/5300 (820:190g); SCI ED 3200; junior standing. (Fall)

### **SCI ED 6299 (820:299). Research.**

Prerequisite(s): consent of department. (Fall, Spring, Summer)

### **SCI ED 6400 (820:270). Special Problems in Science Education — 1-3 hrs.**

Problems selected according to needs of students. May be repeated for maximum of 6 credit hours. (Variable)

### **SCI ED 6500. Research Methods in Science Education — 3 hrs.**

Introduction to qualitative, quantitative, and mixed methods research used in science education. Emphasis on and critical analysis of primary literature. Application of literature review, research design, data analysis and writing styles to graduate projects. (Even Springs)

### **SCI ED 6600 (820:294). Developing Science Curricula — 2 hrs.**

Analysis and design of science curricula with attention to K-12 national and state initiatives and standards. Seminar format, 2 hours/week. (Even Falls)

### **SCI ED 6700 (820:200). The History, Philosophy, and Nature of Science — 2 hrs.**

Examination of the nature of science, major philosophical and historical developments of science, and their implications to the science classroom. Seminar format, 2 hours/week. (Odd Summers)

### **SCI ED 6800 (820:213). Teaching-Learning Models in Science Education — 2 hrs.**

Study of learning theories from behaviorism to constructivism and how these theories are translated into science teaching practice through various teaching models. Seminar format, 2 hours/week. (Odd Falls)

### **SCI ED 6900 (820:290). Trends and Issues in Science Education — 2 hrs.**

Major trends and issues in science education, focusing primarily from the 1950s to the present. Seminar format, 2 hours/week. (Even Summers)