Science Education

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 director. 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 programs are offered in science education:

Undergraduate Majors (B.A.)

- Comprehensive Secondary Science-Teaching (p. 1)
- Middle Level Science-Teaching (Dual) (p. 2)

Minor

- Basic Science (K-8)-Teaching (p. 2)
- STEM Education Minor (p. 2)

Graduate Major (M.A.)

- Science Education (p. 4)

Bachelor of Arts Degree Programs

Comprehensive Secondary Science-Teaching

The Comprehensive Secondary Science Teaching major requires a minimum of 120 total hours to graduate. This total includes UNIFI/General Education requirements, the Professional Education Requirements, and the following specified major requirements to complete the minimum of 120 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	Orientation to Science Teaching (Teaching)	4
SCI ED 4800/5800	Methods for Teaching Secondary Science or MTSS	3
Biology:		
BIOL 2051	General Biology: Organismal Diversity	4
BIOL 2052	General Biology: Cell Structure and Function	4
BIOL 3100	Evolution, Ecology and the Nature of Science	3
BIOL 3140	Genetics	4
Chemistry and Biochemistry:		
CHEM 1110	General Chemistry I	4
CHEM 1120	General Chemistry II *	4
Earth Science:		
EARTHSCI 1300	Introduction to Geology	4
EARTHSCI 1320	Earth History	4
Physics:		
PHYSICS 1511	General Physics I	4
PHYSICS 1512	General Physics II **	4
Electives from the following:		
Chemistry and Biochemistry:		7
CHEM 2040	Applied Organic and Biochemistry	
or CHEM 2210	Organic Chemistry I	
plus one 2000-level course ^		
Earth Science:		
EARTHSCI 1100	Astronomy	3
EARTHSCI 1110	Astronomy Laboratory	1
EARTHSCI 1200	Elements of Weather	3
EARTHSCI 1210	Elements of Weather Laboratory	1
Physics:		
any 2000-level course		7
Teaching		
TEACHING 3129	Secondary and Special-Area Classroom Management	1
Total Hours		**69**

* Students with excellent preparation in chemistry may substitute CHEM 1130 plus 3 hours of additional credit hours in chemistry electives for CHEM 1110 and CHEM 1120.

** Students with excellent preparation in physics and calculus may substitute PHYSICS 1701 and PHYSICS 1702 for PHYSICS 1511 and PHYSICS 1512

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.

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.

Middle Level Science-Teaching (Dual)

The Middle Level Science Teaching (Dual) major requires a minimum of 120 total hours to graduate. This total includes UNIFI/General Education requirements, the Professional Education Requirements, and the following specified major requirements to complete the minimum of 120 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.

The Middle-Level Science Teaching (Dual) major is waived from the 10-hour upper level requirement.

Middle Level Science Teaching Dual majors may substitute TEACHING 3129 (1 hr.) for the following Middle Level Education Dual major requirement: ELEMECML 3120 or EDPSYCH 4151/5151 (3 hrs.).

Required		
Science Education:		
SCI ED 3300/5300	Orientation to Science Teaching	4
SCI ED 4800/5800	Methods for Teaching Secondary Science or MTSS	3
Biology:		
BIOL 2051	General Biology: Organismal Diversity	4
BIOL 2052	General Biology: Cell Structure and Function	4
Chemistry and Biochemistry:		
CHEM 1110	General Chemistry I	4
CHEM 1120	General Chemistry II *	4
Earth Science:		
EARTHSCI 1200	Elements of Weather	3
EARTHSCI 1210	Elements of Weather Laboratory	1
EARTHSCI 1300	Introduction to Geology	4
Physics:		
PHYSICS 1511	General Physics I	4
PHYSICS 1512	General Physics II	4
Total Hours		**39**

* Students with excellent preparation in chemistry may substitute CHEM 1130 plus 3 hours of additional credit hours in chemistry electives for CHEM 1110 and CHEM 1120.

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 or MATH 1140 .

Minor

Basic Science Minor (K-8)-Teaching

The Basic Science Minor (K-8)-Teaching is offered to Elementary Education majors. and leads to the State of Iowa endorsement #150 in Basic Science (K-8).

Required		
Curriculum and Instruction:		
ELEMECML 3161	Teaching Elementary School Science *	3
Science and Science Education:		
SCI ED 1100	Inquiry into Earth and Space Science	4
SCI ED 1200	Inquiry into Life Science	4
SCI ED 1300	Inquiry into Physical Science	4
Biology:		4
Select one of the following:		
BIOL 1012 & BIOL 1013	Life: The Natural World and Life: The Natural World - Lab	
BIOL 1014 & BIOL 1015	Life: Continuity and Change and Life: Continuity and Change - Lab	
Earth Science:		4
Select one of the following:		
EARTHSCI 1100 & EARTHSCI 1110	Astronomy and Astronomy Laboratory	
EARTHSCI 1200 & EARTHSCI 1210	Elements of Weather and Elements of Weather Laboratory	
EARTHSCI 1300	Introduction to Geology	
Chemistry and Biochemistry:		
CHEM 1010 or CHEM 1020	Principles of Chemistry Chemical Technology	4
Physics:		
PHYSICS 1000 & PHYSICS 1010	Physics in Everyday Life and Physics in Everyday Life Laboratory	4
Total Hours		**31**

* ELEMECML 3161 has a prerequisite of ELEMECML 4150 or ELEMECML 4151/5151; junior standing.

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 34-35 total credit hours to complete, depending on course choices. This total includes courses that meet either UNIFI/General Education 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 *^.** Students interested in this minor should consult with the STEM Education advisor for assistance with selecting the appropriate courses. The Director of Science Education may also be contacted for assistance.

Group 1 - STEM Education Minor Required Core Classes (13-14 hours)		
Computer Science		3
CS ED 1320	Fundamentals of Programming ^	
or		
CS ED 1310	Programming Environments for Elementary Education *	
Mathematics		3
MATH 3213	Topics in Mathematics for Grades K-8 *	
or		
MATH 2313	Topics in Secondary Mathematics ^	
Science Education		3-4
ELEMECML 3100/5100	Integrating Science, Technology, Engineering, and Mathematics in the Elementary Classroom *%	
or		
SCI ED 3300/5300	Orientation to Science Teaching ^	
Technology		3
TECH TEE 1000	Introduction to Technology and Engineering Education	
Studies in STEM Experiences		1
4186/5186 Studies in STEM Experiences*^ with department options of CS 4186/5186, MATH 4186/5186, SCI ED 4186/5186, or TECH 4186/5186 (1 hour)		
Group 2 - Mathematics Content Electives [1]		**6**
MATH 1420	Calculus I ^	
MATH 1421	Calculus II ^	
MATH 2204	Mathematical Reasoning for Elementary Teachers II *	
MATH 3204	Mathematical Reasoning for Elementary Teachers III *	
MATH 3211	Algebra *	
MATH 3212	Introduction to Geometry and Measurement for Elementary Teachers *	
MATH 3214	Problem Solving in Mathematics for Elementary Teachers *	
MATH 2500	Linear Algebra for Applications ^	
MATH 3530/5530	Combinatorics ^	
MATH 3600/5600	Euclidean Geometry ^	
MATH 3610/5610	Modern Geometries ^	
MATH 3751	Probability and Statistics ^	
STAT 1772	Introduction to Statistical Methods ^	
or STAT 1774	Introductory Statistics for Life Sciences	
Group 3 - Science Content Electives [2]		**12**
BIOL 2051	General Biology: Organismal Diversity ^	
BIOL 2052	General Biology: Cell Structure and Function ^	
BIOL 3181	Investigations in Life Science *	
CHEM 1020	Chemical Technology ^	
CHEM 1110	General Chemistry I ^	
CHEM 1130	General Chemistry I-II ^	
EARTHSCI 1300	Introduction to Geology ^	
EARTHSCI 1320	Earth History ^	
EARTHSCI 3500	Investigations in Earth and Space Sciences *	
PHYSICS 1511	General Physics I ^	
PHYSICS 1701	Physics I for Science and Engineering ^	
SCI ED 2300	Investigations in Physical Science *[3]	
Group 4 - Technology Electives		**3**
TECH TEE 2020	Transportation Technology ^	
PHYSICS 3030	Robotics and Sensors ^	
TECH 3164	Programmable Logic Controllers (PLCs) ^	
CS ED 3310/5310	Teaching and Learning Programming *^	
Total Hours		**34-35**

Notes:

[1] Students must earn a minimum of 12 credit hours in Mathematics to earn the endorsement, including MATH 3213 or MATH 2313 from Group 1. Additionally, the Computer Science courses, CS ED 1310 or CS ED 1320, from Group 1 count toward fulfilling the 12 hour Mathematics requirement.

[2] Science content courses must include a minimum of 1 Biology, 1 Earth Science, and 1 Physics or Chemistry course.

[3] SCI ED 2300 is counted as fulfilling the Chemistry or Physics requirement.

* Course best fits those seeking an elementary education degree.

^ Course best fits those seeking a secondary education degree.

*^Course best fits those seeking an elementary education or secondary education degree.

%ELEMECML 3100/5100 has a prerequisite of two courses from SCI ED 1200, SCI ED 1300, and SCI ED 1100 OR approval of the instructor; junior standing.

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 the Science Education Graduate Coordinator. Graduate information and application for graduate admission can be found at https://admissions.uni.edu/application.

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 for thesis research and writing, is required for the **thesis** option; a **minimum of 30 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 6000-level course work is required for the thesis option. A minimum of 14 hours of 6000-level course work is required for the non-thesis option.**

Required

Measurement and Research:		
SCI ED 6500	Research Methods in Science Education	4
Science and Science Education:		
SCI ED 6600	Developing Science Curricula	2
SCI ED 6700	The History, Philosophy, and Nature of Science	3
SCI ED 6800	Teaching-Learning Models in Science Education	2
SCI ED 6900	Trends and Issues in Science Education	3
Thesis or non-thesis option research and electives		16
Total hours thesis or non-thesis option		30

Thesis Option

Research:		
SCI ED 6299	Research	6
Science content courses		6
Electives from education or science education		4
Total Hours		**16**

Non-Thesis Option

Research:		
SCI ED 6299	Research	3
Science content courses		8
Electives from education or science education		5
Total Hours		**16**

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.

Comprehensive Secondary Science Teaching, B.A.

Goal 1: Demonstrate Knowledge of Science and Scientific Practices

Outcome:

1.1. Students will demonstrate an understanding of science content and scientific practices to advance student learning in a secondary science classroom.

Goal 2: Demonstrate Knowledge and Pedagogical Practices for Teaching Science

Outcomes:

2.1. Students will design instruction that have clear and challenging objectives with assessments in alignment with those objectives that actively engages students in science and science practices as recommended by national and state standards.

2.2. Students will implement effective teaching practices based on research and national and state standards including the use of technology to address the needs and advance learning of all students in a science classroom.

Goal 3: Demonstrate Professional Growth as a Science Teacher

Outcome:

3.1. Engage in relevant activities and reflective practices that lead to professional growth and life-long learning.

Middle Level Science Teaching (Dual), B.A.

Goal 1: Demonstrate Knowledge of Science and Scientific Practices

Outcome:

1.1. Students will demonstrate an understanding of science content and scientific practices to advance student learning in a secondary science classroom.

Goal 2: Demonstrate Knowledge and Pedagogical Practices for Teaching Science

Outcomes:

2.1. Students will design instruction that have clear and challenging objectives with assessments in alignment with those objectives that actively engages students in science and science practices as recommended by national and state standards.

2.2. Students will implement effective teaching practices based on research and national and state standards including the use of

technology to address the needs and advance learning of all students in a science classroom.

Goal 3: Demonstrate Professional Growth as a Science Teacher

Outcome:

3.1. Engage in relevant activities and reflective practices that lead to professional growth and life-long learning.

Science Education, M.A.

Goal 1: Educate practicing science teachers in science education theories, philosophies of science, educational research methods, and curriculum development in science education to influence change in teaching practice.

Outcomes:

1.1 – Students will analyze how a selected historical philosophical framework has changed to a philosophical framework that guides their science teaching practices, the form of scientific method they use and their working definition of science. These are measured by Rubric Score on Final Paper assignment in SCI ED 6700.

1.2 – Students will identify a science teaching technique informed by behaviorism, a separate science teaching technique informed by constructivism, provide examples of the use of these techniques, and demonstrate how the major ideas of behaviorist and constructivist models of teaching and learning inform these approaches. These are measured by rubric scores on the Observation and Planning Assignment options in SCI ED 6800.

1.3 – Students will synthesize the existing literature to develop and propose one or more research questions in science education and design a study that will answer the stated research question(s). These are measured by completion and rubric evaluation of final paper/ project proposal in SCI ED 6500.

1.4 – Students will explain the inside and outside influences acting in curriculum development, subject matter, pedagogy & learning, and assessment/evaluation during the past 100 years and the resulting science education framework. These are measured by Rubric Scores on course-long project in SCI ED 6900.

1.5 – Students will describe the role of each of the three components of science curriculum (aims of education, goals of science education, and curriculum framework) in their personal approach to teaching. These are measured by combined Rubric Scores for three separate assignments in SCI ED 6600.

Goal 2: Make and communicate a scholarly contribution to science education, demonstrating their ability to reflect on the impact of this contribution and its connection to significant knowledge acquired in the master's program and relevant science education research.

Outcomes:

2.1 – Students will design, conduct/produce, and analyze a scholarly endeavor in science education.

2.2 – Students will discuss results of their scholarly endeavor in the context of existing science education literature and to reflect on the potential impact of these results on the science teaching practitioner and/or science education professional community. Both Goal 2 outcomes measured by: Completion, presentation and acceptance (via an average score of 3) on the Cumulative Scholarly Work rubric of the thesis or non-thesis paper.