

DEPARTMENT OF BIOLOGY
Master of Arts in Education in Science Education

PROGRAM OVERVIEW

The graduate Science Education program at UNC Pembroke consists of the Master of Arts (M.A.) in Science Education and the Master of Arts in Teaching (M.A.T.) Program with Science Specialization. The M.A. in Science Education Program at UNC Pembroke has two concentrations: Licensure and Non-Licensure. The Licensure Concentration is designed to prepare currently licensed secondary school science teachers for the North Carolina Master's/Advanced Competencies License. The Non-Licensure Concentration is designed for applicants who meet all graduate school admission requirements with the exception of the teaching licensure requirement. Candidates completing the Non-Licensure Concentration are not eligible for North Carolina Standard Professional 1 or M level licensure and must sign a waiver to that effect upon admission. The Non-Licensure Concentration will not be discussed in this report.

The M.A.T. Program with Science Specialization is designed to prepare candidates to meet competencies of both Standard Professional 1 and M licenses. The Science Education Graduate Program nurtures the development of science teachers and further develops the instructional expertise and leadership qualities and skills of science teachers. The graduate Science Education program is accredited by the North Carolina Department of Public Instruction, the National Council for the Accreditation of Teacher Education (NCATE), and the Southern Association of Colleges and Schools (SACS). The Science Education Graduate Program is governed by the Teacher Education Committee and the Graduate Council. The Science Education Graduate Program is guided by an advisory council comprised of representatives from the Departments of Biology, Geology, and Chemistry and Physics, the School of Education, public school teachers and administrators, graduates, and current candidates.

Program of Study

Program Goals and Objectives

M.A. Science Education

The goals of the program are designed to prepare a student to be able to:

1. Apply the theoretical, philosophical, and research bases for educational practice in secondary school classrooms to improve student learning.
2. Plan, implement, and evaluate instruction that is philosophically consistent with the Constructivist viewpoint.
3. Incorporate knowledge of the nature of the learner, learning process, variations in learning abilities and learning styles, and strategies for evaluating learning in the secondary school classroom.

4. Plan, implement, and evaluate instruction that is responsive to wide variations in students' learning needs and learning styles.
5. Understand and employ methods of research to examine and improve instructional effectiveness and student achievement, particularly in the Constructivist science classroom.
6. Understand and link subject matter and students' developmental and diverse needs in the context of secondary science classrooms.
7. Plan, implement, and evaluate instruction that reflects intellectual rigor and depth of knowledge in both science content and students' diverse learning needs.
8. Demonstrate self-directed, self-reflective professional behavior and the importance of providing leadership to colleagues and communities through collaboration and participation in state and national science education organizations.

M.A.T. Science Education

The goals of the program are designed to prepare a student to be able to:

1. Demonstrate breadth of general knowledge, as well as depth of knowledge, in the selected discipline area necessary for effective instructional decision-making.
2. Demonstrate a well-articulated knowledge of elementary, middle or secondary school communities and issues that impact teaching.
3. Exhibit knowledge of and show respect toward diverse cultural values and exceptionalities;
4. Communicate effectively in Standard oral and written English.
5. Adapt instructional strategies to the developmental and learning needs of individuals, including students with special needs and students from culturally diverse backgrounds.
6. Establish a classroom climate conducive to the learning, social, and emotional needs of students.
7. Choose objectives consistent with state and local curriculum guidelines, the learning needs of students, and guidelines established by learned societies.
8. Utilize technology in ways that enhance teaching and learning experiences.
9. Employ and analyze appropriate assessments and evaluative procedures.
10. Establish a pattern of reflective practice and scholarly inquiry culminating in confidence, professionalism, and effectiveness in the role of teacher.
11. Demonstrate knowledge of the history, philosophy and sociology of public education pertaining to the demonstration of best practices in education.
12. Meet departmental requirements for a capstone course, product, and/or examination.

STANDARDS FOR 9 - 12 SCIENCE TEACHERS

Standard 1: Science Teachers understand the unifying concepts of science.

Indicator 1: Science teachers understand the major concepts in life science:

1. Evolution
 - ❖ Characteristics of living things
 - ❖ Diversity of Organisms

- ❖ Life cycles
- ❖ Theory of evolution
- 2. Gene Theory
 - ❖ Mendelian Genetics
 - ❖ DNA and heredity
 - ❖ Mutations/Evolution
- 3. Cell Theory
 - ❖ Structure and Function of cells
 - ❖ Cellular Processes (cellular respiration, photosynthesis, cell transport, mitosis)
 - ❖ Parts of the cell theory
- 4. Form and Function
 - ❖ Structure and Function of plants and animals and their parts
 - ❖ Sexual and Asexual Reproduction
 - ❖ Growth and Development of Organisms
 - ❖ Health and Human Biology
- 5. Ecological Relationships and Interdependence
 - + Organisms in their environments
 - ❖ Food chains and food webs
 - ❖ Cycling of matter and flow of energy
 - ❖ Mutations/Adaptations
 - ❖ Human impact on the environment
 - ❖

Indicator 2: Science teachers understand the major concepts in Physical Science.

1. Measurements
 - ❖ systems of measurements
 - ❖ units (including metric)
 - ❖ dimensional analysis
 - + interpret data, ratios, graphs
2. Atomic Theory and Periodic Law
 - ❖ Structure of atom
 - ❖ Periodic table
 - ❖ Molecules and bonding
3. Structure and Properties of Matter
 - ❖ Classification of Matter (elements, compounds, mixtures, etc.)
 - ❖ States of matter and phase changes
 - ❖ Chemical and physical properties of matter
4. Chemical Reactions
 - ❖ Types of chemical reactions
 - ❖ Factors affecting reactions and reaction rates
5. Forces and Motion
 - ❖ Motion
 - + Vectors and scalars
 - + Circular motion
 - ❖ Rotational motion
 - ❖ Keplers' laws of planetary motion

- 6. Electromagnetism
 - ❖ Static Charge
 - ❖ Moving Charges
 - + Magnetism
 - ❖ Electromagnetic Spectrum
- 7. Waves and Optics
 - ❖ Wave Motion
 - ❖ Wave Nature of Light
 - ❖ Optics
- 8. Energy
 - ❖ Sources and forms of energy
 - ❖ Conservation of energy
 - ❖ Interaction of energy and matter
 - + Thermodynamics
- 9. Modern Physics and Chemistry
 - ❖ Nature of light
 - ❖ Atomic and nuclear structure
 - ❖ Atomic and nuclear energy

Indicator 3: Science teachers understand the major concepts in Earth Science.

- 1. Origin and Evolution of the Earth and Universe
 - ❖ Physical evolution of the earth
 - ❖ Big bang theory
- 2. Astronomy
 - ❖ Planetary astronomy
 - + Deep space astronomy
- 3. Properties of Earth Materials
 - ❖ Composition of earth
 - ❖ Rocks, minerals and fossils
 - ❖ Water and air
- 4. Earth Dynamics/Systems
 - ❖ Lithosphere
 - ❖ Earth's Interior
 - + Atmosphere
 - ❖ Hydrosphere
 - + Energy
- 5. Interaction of the Earth and Living Systems
 - ❖ Management of Natural Resources
 - ❖ Pollution
 - ❖ Energy Resources
 - ❖ Population dynamics
 - ❖ Ecosystems

Standard 2: Science Teachers understand the nature of science and the development of scientific thought.

Science teachers understand:

- Indicator 1: that science is universal and multidisciplinary; that the boundaries of the disciplines are artificial.
- Indicator 2: that knowledge gained through science is based on logic and skepticism.
- Indicator 3: that scientific explanations must be consistent with observations and evidence.
- Indicator 4: that all scientific knowledge is probabilistic and subject to change.
- Indicator 5: the importance of communication within the scientific community and with the public, allowing for feedback, challenges, and peer review.

Standard 3: Science teachers understand the historical development of scientific thought and the application of science in society.

Science teachers understand:

- Indicator 1: the development of the major scientific advances and that scientific knowledge builds on previous knowledge.
- Indicator 2: that the historical development of scientific thought has not been necessarily linear.
- Indicator 3: that diverse cultures have contributed to scientific knowledge.
- Indicator 4: that major scientific advances have affected and changed human society. (Examples are: health, transportation, communication, economics, industrialization, politics, and information.)
- Indicator 5: the reciprocal relationship between the development of scientific concepts and the technological application of these concepts in society.

Standard 4: Science teachers understand the math concepts and processes and the technologies that are used in science.

Science teachers:

- Indicator 1: Have a conceptual understanding of mathematics as appropriate to the science content that they teach.
- Indicator 2: Understand systems of measurement, degrees of magnitude, significant figures, dimensional analysis, and precision and accuracy as appropriate to each content area.
- Indicator 3: Know how to chart and graph data, selecting the appropriate graph for specific data and specific purposes.
- Indicator 4: Know how to use mathematics and technology in modeling and simulations as appropriate to each content area.

Standard 5: Science teachers use developmentally appropriate strategies to design and deliver instruction in science.

Science teachers:

- Indicator 1: Develop and implement instruction consistent with the North Carolina Science Standard Course of Study.
- Indicator 2: Understand and integrate other subjects with science content.
- Indicator 3: Apply reading strategies to teach reading in the science content area.
- Indicator 4: Apply learning and motivational theory in the development, delivery, and assessment of science curricula.
- Indicator 5: Promote new learning through using students' prior knowledge and misconceptions and consider student interest in designing lessons.
- Indicator 6: Apply various models of science teaching at appropriate developmental levels.
- Indicator 7: Integrate appropriate technologies to improve the delivery of science instruction.
- Indicator 8: Create/adapt science lessons and investigations from various sources that focus on local, relevant applications.
- Indicator 9: Use questioning techniques that lead to student understanding of scientific concepts.
- Indicator 10: Implement a variety of teaching and communication strategies for science instruction

Standard 6: Science teachers plan and implement appropriate scientific investigations to develop problem solving and critical thinking skills in science.

Science Teachers:

- Indicator 1: Manage instructional time by developing a variety of inquiry-based lessons and investigations that are designed for teaching specific concepts.
- Indicator 2: Use various questioning skills appropriate for inquiry-based instruction.
- Indicator 3: Develop science process skills through appropriate inquiry-based lessons.
- Indicator 4: Plan strategies for the use of cooperation/collaboration skills in the scientific investigations.
- Indicator 5: Integrate technology for delivering content, collecting and analyzing data, and communicating results.
- Indicator 6: Incorporate appropriate field investigations and field trips into the science curriculum.
- Indicator 7: Incorporate safety laws, codes, and standards in the planning and implementation of science instruction.
- Indicator 8: Plan for acquisition, dissemination, and management of materials and equipment.

Standard 7: Science teachers organize and manage the science learning environment to ensure optimal learning.

Science teachers:

- Indicator 1: Guide students to work in collaborative teams and encourage them to evaluate constructively.
- Indicator 2: Design and implement procedures that enhance the organization and management of the science classroom.
- Indicator 3: Organize and manage field investigations and field trips to optimize efficiency and safety.
- Indicator 4: Organize and manage the use of technologies where appropriate for optimal learning.
- Indicator 5: Apply *Safety Laws, Codes, and Standards* to laboratory and field-work procedures.

Standard 8: Science teachers create and use appropriate assessment strategies and instruments to improve science instruction for all students.

Science teachers:

- Indicator 1: Develop a variety of formal and alternative assessment strategies appropriate for individual, peer, team, and collaborative skills in science.
- Indicator 2: Effectively use diagnostic assessment of science content and process skills.
- Indicator 3: Use a variety of questioning techniques to determine level of student understanding of scientific concepts.
- Indicator 4: Develop and use rubrics in assessment.
- Indicator 5: Use technology as appropriate in the evaluation of scientific knowledge and skills.

Standard 9: Science teachers integrate appropriate technology to enhance instruction in science and scientific investigation.

Science Teachers:

- Indicator 1: Select appropriate technologies for teaching specific science concepts.
- Indicator 2: Use technology to develop appropriate simulations of scientific concepts.
- Indicator 3: Guide students in the appropriate use of multimedia and web-based research.
- Indicator 4: Guide students in data collection, analysis and interpretation using computers and other scientific instruments.
- Indicator 5: Guide students in using appropriate technologies to communicate and present results.
- Indicator 6: Model the use of appropriate technology in instruction.

- Indicator 7: Demonstrate and model the ethical and legal use of technology

Standard 10: Science teachers develop strategies to address science topics that are controversial to diverse groups.

Science teachers:

- Indicator 1: Understand and respect that families and communities may have diverse attitudes about science, inquiry, and specific science-related issues.
- Indicator 2: Promote the open-minded discussion of controversial issues in science by developing and using various strategies such as debates, use of data gathering and analysis for informed decision-making, and recognition of bias and propaganda.
- Indicator 3: Guide students in developing rational solutions to controversial problems in science.

Standard 11: Science teachers encourage underrepresented groups to engage in science

Standard 12: Science teachers work with professional colleagues, parents, and community members to improve science instruction for all students.

Science teachers:

- Indicator 1: Are aware of collaborative efforts and how to integrate them into the science program.
- Indicator 2: Continue to support students as they pursue science.
- Indicator 3: Develop advocacy, communication and leadership skills by attending workshops and staff development opportunities.
- Indicator 4: Know how to locate resources to enhance science instruction.

Standard 13: Science teachers research and learn to apply best practice in science education and participate in the dissemination of those ideas.

Science teachers:

- Indicator 1: Use the information from professional science education organizations to improve content and pedagogy in the science classroom.
- Indicator 2: Attend appropriate professional development opportunities.
- Indicator 3: Collect and use information from the scientific community, business and industry.
- Indicator 4: Understand the importance of collaborating with colleagues as well as with the larger community to improve science instruction.

Standard 14: Science teachers understand safety and liability issues in science and advocate for appropriate safety materials and enforcement practices in the classroom.

Science teachers:

- Indicator 1: Ensure that safety issues are included in instruction and provide supervision during lab and field experiences.
- Indicator 2: Analyze the lab/activities for safety and research materials/chemicals to know safety issues before they are used.
- Indicator 3: Have a working knowledge of and comply with the science *Safety Laws, Codes, and Standards*.
- Indicator 4: Keep MSDS (Material Safety Data Sheets) sheets readily available.
- Indicator 5: Model appropriate safety behaviors.
- Indicator 6: Develop a short and long-term plan for improvement of science safety.

STANDARDS FOR THE MASTER'S DEGREE LICENSE

Standard 1: Instructional Expertise

The candidate demonstrates instructional expertise by applying the theoretical, philosophical, and research bases for educational practice in P-12 settings to improve student learning.

Indicators:

1. The candidate plans, implements, and evaluates instruction that is rigorous, coherent, and consistent with a well-developed theoretical and philosophical base and best practices emerging from educational research.
2. The candidate designs and modifies instruction and learning environments based on assessment of student learning problems and successes.
3. The candidate monitors the effects of instructional actions, selection of materials, and other instructional decisions on students' learning and behavior.
4. The candidate incorporates findings from educational literature into school and classroom strategies to improve student learning.
5. The candidate understands and links subject matter and students' developmental and diverse needs in the context of school settings.
6. The candidate uses technology to create learning environments that support students' learning.
7. The candidate seeks, implements, and evaluates the best pedagogical practices for the subjects taught within the context of a specific school setting.

Standard 2: Knowledge of Learners

The candidate incorporates knowledge of the nature of the learner, learning processes, variations in learning abilities and learning styles, and strategies for evaluating learning into the planning, delivery, and evaluation of instruction.

Indicators:

1. The candidate seeks to increase understanding of and respect for differences in students, including exceptionalities.
2. The candidate designs and delivers instruction that is responsive to differences among all learners.
3. The candidate reflects on and modifies instruction that fosters student learning.
4. The candidate understands and respects differences between the learning behaviors and outcomes expected in diverse communities.
5. The candidate creates and maintains a classroom environment conducive to learning in which all learners feel welcome and can be successful.

Standard 3: Research

The candidate uses research to examine and improve instructional effectiveness and student achievement.

Indicators:

1. The candidate critically reads and applies historical and contemporary educational literature, including theoretical, philosophical, and research materials.
2. The candidate uses student and school performance data to improve student learning, classroom processes, and school practices.
3. The candidate investigates educational problems through action research.

Standard 4: Content Knowledge

The candidate demonstrates advanced depth and breadth of knowledge and skills in the academic discipline and in education.

Indicators:

1. The candidate analyzes and articulates relationships between and among theory, philosophy, research findings, and current practice as appropriate to the discipline.
2. The candidate analyzes and articulates relationships between and among theory, philosophy, research findings, and current practice across disciplines.
3. The candidate demonstrates theoretical and applied advanced content knowledge.
4. The candidate understands current knowledge and trends in education.

Standard 5: Professional Development and Leadership

The candidate engages in continued professional development and provides leadership at the classroom, school, and community levels, and within the profession.

Indicators:

1. The candidate initiates professional inquiry through reading, dialogue, reflection, professional development, and action research.
2. The candidate seeks, evaluates, and as appropriate, acts on input from educators, parents, students, and other members of the community for continuous improvement.
3. The candidate participates, formally and informally, in appropriate professional communities.
4. The candidate participates in collaborative leadership to address educational problems.
5. The candidate provides leadership in working with parents and strengthening the home-school partnership.