

COMPETENCIES FOR SECONDARY TEACHERS: BIOLOGY/LIFE SCIENCE, 7-12

In addition to the Arkansas Teaching Standards (ATS) and the competencies for the Teacher Excellence and Support System (TESS), including competencies regarding the knowledge and use of educational technology that reflect the International Society for Technology in Education standards, the teacher of Biology/Life Science, grades 7-12, shall also demonstrate knowledge and competencies in the following areas:

1. CONTENT KNOWLEDGE

NSTA/ASTE; Standard 1

NRC Framework

PRAXIS (5235): Sections I-VI

NSTA/ASTE Standard 1: Effective teachers of science understand and articulate the knowledge and practices of contemporary science and engineering. They connect important disciplinary core ideas, crosscutting concepts, and science and engineering practices for their fields of licensure

1.1 Uses and applies major concepts, principles, theories, laws, and interrelationships of their fields of licensure and supporting fields. Explains the nature of science and the cultural norms and values inherent to the current and historical development of scientific knowledge

1.2 Demonstrates knowledge of crosscutting concepts, disciplinary core ideas, practices of science and engineering, the supporting role science-specific technologies, and contributions of diverse populations to science

1.3 Demonstrates knowledge of how to implement science standards, learning progressions, and sequencing of science content for teaching their licensure level PK-12 students

NRC Framework: Core Component Ideas in the Life Sciences:

1.4 Core Idea LS1: From Molecules to Organisms: Structures and Processes

- LS1.A: Structure and Function
- LS1.B: Growth and Development of Organisms
- LS1.C: Organization for Matter and Energy Flow in Organisms
- LS1.D: Information Processing

1.5 Core Idea LS2: Ecosystems: Interactions, Energy, and Dynamics

- LS2.A: Interdependent Relationships in Ecosystems
- LS2.B: Cycles of Matter and Energy Transfer in Ecosystems
- LS2.C: Ecosystem Dynamics, Functioning, and Resilience
- LS2.D: Social Interactions and Group Behavior

1.6 Core Idea LS3: Heredity: Inheritance and Variation of Traits

- LS3.A: Inheritance of Traits
- LS3.B: Variation of Traits

COMPETENCIES FOR SECONDARY TEACHERS: BIOLOGY/LIFE SCIENCE, 7-12

- 1.7 Core Idea LS4: Biological Evolution: Unity and Diversity
 - LS4.A: Evidence of Common Ancestry and Diversity
 - LS4.B: Natural Selection
 - LS4.C: Adaptation
 - LS4.D: Biodiversity and Humans
- 1.8 Core Idea ESS1: Earth's Place in the Universe
 - ESS1.B: Earth and the Solar System
- 1.9 Core Idea ESS2: Earth's Systems
 - ESS2.A: Earth Materials and Systems
 - ESS2.C: The Roles of Water in Earth's Surface Processes
 - ESS2.D: Weather and Climate
 - ESS2.E: Biogeology
- 1.10 Core Idea ESS3: Earth and Human Activity
 - ESS3.A: Natural Resources
 - ESS3.B: Natural Hazards
 - ESS3.C: Human Impacts on Earth Systems
 - ESS3.D: Global Climate Change

2. CONTENT PEDAGOGY

NSTA/ASTE; Standard 2

NSTA/ASTE Standard 2: Effective teachers of science plan learning units of study and equitable, culturally responsive opportunities for all students based upon their understanding of how students learn and develop science knowledge, skills, and habits of mind. Effective teachers also include appropriate connections to science and engineering practices and crosscutting concepts in their instructional planning

2.1 Uses science standards and a variety of appropriate, student-centered, and culturally relevant science disciplinary-based instructional approaches that follow safety procedures and incorporate science and engineering practices, disciplinary core ideas, and crosscutting concepts

2.2 Incorporates appropriate differentiation strategies, wherein all students develop conceptual knowledge and an understanding of the nature of science. Lessons should engage students in applying science practices, clarifying relationships, identifying natural patterns and empirical experiences

2.3 Uses engineering practices in support of science learning wherein all students design, construct, test and optimize possible solutions to a problem

COMPETENCIES FOR SECONDARY TEACHERS: BIOLOGY/LIFE SCIENCE, 7-12

2.4 Aligns instruction and assessment strategies to support instructional decision making that identifies and addresses student misunderstandings, prior knowledge, and naïve conceptions

Possible assessment types to use in instruction:

Summative assessments are performed in periodic intervals to assess a collection of knowledge at a particular point in time. Summative assessments may take the form of traditional assessments, including quizzes, exams, lab reports, and term papers but may also include projects, posters, presentations, etc.

Student self-assessment could be in the form of a journal that is used to encourage students to reflect and assess their progress

Performance-based assessments have proven to be effective in assessing three-dimensional learning. This requires students to demonstrate content knowledge (DCIs), the ability to make connections (CCCs), and developing solutions to solve a problem (SEPs)

Model-based assessment allows students to demonstrate content knowledge. The creative diagramming aspect of the model means that students, especially English language learners (ELLs), can demonstrate content understanding without being bogged down by vocabulary; they can show their comprehension is deeper than vocabulary

Third party assessment tools have the advantage of being unbiased and statistically valid. Local, district, and state assessments may be examples of third-party assessments, including end-of-course exams. Some tools, such as those from the ACS Exams Institute, can provide objective national or regional performance rankings

2.5 Integrates science-specific technologies to support all students' conceptual understanding of science and engineering

3. LEARNING ENVIRONMENTS

NSTA/ASTE; Standard 3

NSTA/ASTE Standard 3: Effective teachers of science are able to plan for engaging all students in science learning by identifying appropriate learning goals that are consistent with knowledge of how students learn science and are aligned with standards. Plans reflect the selection of phenomena appropriate to the social context of the classroom and community, and safety considerations, to engage students in the nature of science and science and engineering practices. Effective teachers create an anti-bias, multicultural, and social justice-learning environment to achieve these goals

COMPETENCIES FOR SECONDARY TEACHERS: BIOLOGY/LIFE SCIENCE, 7-12

3.1 Plans a variety of lesson plans based on science standards that employ strategies that demonstrate their knowledge and understanding of how to select appropriate teaching and motivating learning activities that foster an inclusive, equitable, and anti-bias environment

3.2 Plans learning experiences for all students in a variety of environments (e.g., laboratory, field and community) within their fields of licensure

3.3 Plans lessons in which all students have a variety of opportunities to investigate, collaborate, communicate, evaluate, revise, and defend their own explanations of: scientific phenomena, observations, and data



4. SAFETY

NSTA/ASTE; Standard 4

PRAXIS (5235): Section I



NSTA/ASTE Standard 4: Effective teachers of science demonstrate biological, chemical, and physical safety protocols in their classrooms and workspace. They also implement ethical treatment of living organisms and maintain equipment and chemicals as relevant to their fields of licensure

4.1 Implements activities appropriate for the abilities of all students that demonstrate safe techniques for the procurement, preparation, use, storage, dispensing, supervision, and disposal of all materials

4.2 Demonstrates the awareness to recognize, prevent, and appropriately respond to hazardous situations (i.e. manage overcrowding; implement emergency procedures; maintain safety equipment; provide adequate student instruction and supervision; and follow policies and procedures that comply with established state and national guidelines, appropriate legal state (Arkansas Code Annotated § 6-10-113 [2012] for eye protection) and national safety standards (e.g., OSHA, NFPA, EPA), and best professional practices (e.g., NSTA, NSELA))

4.3 Demonstrates ethical decision-making with respect to safe and humane treatment of all living organisms in and out of the classroom, and comply with the legal restrictions and best professional practices on the collection, care, and use of living organisms as relevant to their fields of licensure

COMPETENCIES FOR SECONDARY TEACHERS: BIOLOGY/LIFE SCIENCE, 7-12

5. IMPACT ON STUDENT LEARNING

NSTA/ASTE; Standard 5

NSTA/ASTE Standard 5: Effective teachers of science provide evidence that students have learned and can apply disciplinary core ideas, crosscutting concepts and science and engineering practices because of instruction. Effective teachers analyze learning gains for individual students, the class as a whole, and subgroups of students disaggregated by demographic categories, and use these to inform planning and teaching

5.1 Implements assessments that show all students have learned and can apply disciplinary knowledge, nature of science, science and engineering practices, and crosscutting concepts in practical, authentic, and real-world situations

5.2 Collects, organizes, analyzes, and reflects on formative and summative evidence and uses those data to inform future planning and teaching

5.3 Analyzes science-specific assessment data based upon student demographics, categorizing the levels of learner knowledge, and reflect on results for subsequent lesson plans

6. PROFESSIONAL KNOWLEDGE AND SKILLS

NSTA/ASTE; Standard 6

New America

NSTA/ASTE Standard 6: Effective teachers of science strive to continuously improve their knowledge of both science content and pedagogy, including approaches for addressing inequities and inclusion for all students in science. They identify with and conduct themselves as part of the science education community

6.1 Engages in critical reflection on their own science teaching to continually improve their instructional effectiveness

6.2 Participates in professional development opportunities to deepen their science content knowledge and practices

6.3 Participates in professional development opportunities to expand their science-specific pedagogical knowledge

New America:

6.4 Reflects on one's cultural lens

6.5 Promotes respect for students' differences

6.6 Collaborates with families and the local community

COMPETENCIES FOR SECONDARY TEACHERS: BIOLOGY/LIFE SCIENCE, 7-12

7. INCORPORATES CROSSCUTTING CONCEPTS

NRC Framework

Praxis (5235): Section I

- 7.1 Understands and exhibits knowledge of patterns
- 7.2 Understands and exhibits knowledge of cause and effect and mechanism and explanation
- 7.3 Understands and exhibits knowledge of scale, proportion, and quantity
- 7.4 Understands and exhibits knowledge of systems and system models
- 7.5 Understands and exhibits knowledge of energy and matter, flows, cycles, and conservation
- 7.6 Understands and exhibits knowledge of structure and function
- 7.7 Understands and exhibits knowledge of stability and change
- 7.8 Teacher candidates will facilitate opportunities for 7-12 students to identify and demonstrate understanding of these crosscutting concepts

8. INCORPORATES SCIENCE AND ENGINEERING PRACTICES

NRC Framework

Praxis (5235): Section I

8.1 Knows and practices the eight practices of science and engineering that the Framework (NRC) identifies as essential for all students to learn and describes in detail are listed below:

- Asks questions (for science) and defining problems (for engineering)
- Develops and uses models
- Plans and carries out investigations
- Analyzes and interprets data
- Uses mathematics and computational thinking
- Constructs explanations (for science) and designs solutions (for engineering)
- Engages in argument from evidence
- Obtains, evaluates, and communicates information

8.2 Teacher candidates will facilitate opportunities for 7-12 students to demonstrate application of the Science and Engineering Practices

COMPETENCIES FOR SECONDARY TEACHERS: BIOLOGY/LIFE SCIENCE, 7-12

9. INCORPORATES HISTORY AND NATURE OF SCIENCE

NRC Framework

Praxis (5235): Section I

- 9.1 Applies appropriate practices and knowledge to show scientific investigations use a variety of methods
- 9.2 Applies appropriate practices and knowledge to show scientific knowledge is based on empirical evidence
- 9.3 Applies appropriate practices and knowledge to show scientific knowledge is open to revision in light of new evidence
- 9.4 Applies appropriate practices and knowledge to scientific models, laws, mechanisms, and theories that explain natural phenomena
- 9.5 Applies appropriate practices and knowledge to show science is a way of knowing
- 9.6 Applies appropriate practices and knowledge to demonstrate scientific knowledge assumes an order and consistency in natural systems
- 9.7 Applies appropriate use of scientific measurement and notation systems (i.e., precision vs accuracy, metric and SI units, unit conversions, scientific notation and significant figures, linear vs. logarithmic scales [e.g., pH])
- 9.8 Teacher candidates will facilitate opportunities for 7-12 students to demonstrate application of the History and Nature of Science

10. ANCHORING INSTRUCTION IN PHENOMENA

*Seeing Students Learn Science:
Integrating Assessment and
Instruction in the Classroom:
National Academies Press*

- 10.1 Engages students in active science thinking
- 10.2 Helps students make connections and to understand how science ideas are important
- 10.3 Identifies phenomena that describe events or facts that can be observed, unusual or not
- 10.4 Engages students in making sense of novel phenomena to gain conceptual understanding of what they observe in the world
- 10.5 Elicits students' natural curiosity about something that can be explained scientifically
- 10.6 Develops a range of activities that allow students to develop three-dimensional understanding of the core ideas and cross cutting concepts while using science and engineering skills

COMPETENCIES FOR SECONDARY TEACHERS: BIOLOGY/LIFE SCIENCE, 7-12

11. SUPPORTING COMPETENCIES

NSTA-LS

ACS

AR SS

11.1 Mathematics:

- Understands how statistics are used by scientists to support arguments
- Understands how mathematical models used in life sciences

11.2 Earth and Space Science:

- Understands how Earth's major systems interact to impact Earth processes
- Understands how humans depend on Earth's resources
- Understands what human activities have positively and negatively impacted Earth's climate
- Understands how the chemical and physical properties of water and its movement create changes in the surface and subsurface of the Earth

11.3 Chemistry:

- Understands what is matter
- Understands what trends exist in the Periodic Table and how those trends reflect atomic structure
- Understands how atoms combine to form novel substances
- Understands what conventions chemists use for naming chemical compounds and writing chemical formulas
- Understands how a balanced chemical reaction represents conservation of mass in a given chemical reaction
- Understands how half-life is used to determine the age of rocks and other natural materials

11.4 Physics:

- Understands what is energy and how is it measured
- Understands how is energy transferred between objects
- Understands what are the conceptual and mathematical relationships among energy, work, and power
- Understands what is meant by conservation of energy and conservation of mass
- Understands the relationship between thermal energy and temperature

12. SCIENTIFIC PROCEDURES AND TECHNIQUES

Praxis (5235): Section I

12.1 Understands how to collect, evaluate, manipulate, interpret, and report data

- Significant figures in collected data and calculations
- Organization and presentation of data
- Knows how to interpret and draw conclusions from data presented in tables, graphs, and charts (e.g., trends in data, relationships between variable, predictions, and conclusions based on data)