

Competencies for Secondary Teachers: Physical Science, Grades 7-12

2013

In addition to the Arkansas Teaching Standards, the teacher of Physical Science, grades 7-12, shall demonstrate knowledge and competencies in the following areas:

<p>1. Central concepts or current theories of Physical Science</p> <p>NRC Framework: Praxis II (0481): IIB, IIIA-B</p>	<p>1.1 Ability to demonstrate a knowledge of energy and matter 1.2 Ability to demonstrate knowledge of waves 1.3 Ability to demonstrate knowledge of heat and thermodynamics 1.4 Ability to demonstrate knowledge of atomic and nuclear structure</p>
<p>2. Principles of Physical Sciences</p> <p>NRC Framework: CCSS - English/Language Arts: English Language Arts & Literacy in Science, and Technical Subjects, grades 7-12 CCSS – Mathematics, grades 7-12 Praxis II (0481): IIB, IIIA-B</p>	<p>2.1 Ability to demonstrate a deep understanding following active investigations in the principles of matter and its interactions including</p> <ul style="list-style-type: none"> • Structure and Properties of Matter • Chemical Reactions • Nuclear Processes <p>2.2 Ability to demonstrate a deep understanding following active investigations in the principles of motion and stability: forces and interactions including</p> <ul style="list-style-type: none"> • Forces and Motion • Types of Interactions • Stability and Instability in Physical Systems <p>2.3 Ability to demonstrate a deep understanding following active investigations in the principles of energy including</p> <ul style="list-style-type: none"> • Definitions of Energy • Conservation of Energy and Energy Transfer • Relationship Between Energy and Forces • Energy in Chemical Processes and Everyday Life <p>2.4 Ability to demonstrate a deep understanding following active investigations in the principles of waves and their applications in technologies for information transfer including</p> <ul style="list-style-type: none"> • Wave Properties • Electromagnetic Radiation • Information Technologies and Instrumentation
<p>3. Incorporate Crosscutting Concepts</p> <p>NRC Framework: Praxis II (0481): IA, IIB, IIIA</p>	<p>3.1 Ability to understand and exhibit knowledge of patterns 3.2 Ability to understand and exhibit knowledge of cause and effect and mechanism and explanation 3.3 Ability to understand and exhibit knowledge of scale, proportion, and quantity 3.4 Ability to understand and exhibit knowledge of systems and system models 3.5 Ability to understand and exhibit knowledge of energy and matter, flows, cycles, and conservation 3.6 Ability to understand and exhibit knowledge of structure and function</p>

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	3.7 Ability to understand and exhibit knowledge of stability and change
<p>4. Incorporate Science and Engineering Practices</p> <p>NRC Framework: Praxis II (0481): IA-B</p>	<p>4.1 Knowledge and practice of the eight practices of science and engineering that the NRC Framework identifies as essential for all students to learn and describe in detail are listed below:</p> <ul style="list-style-type: none"> • Asking questions (for science) and defining problems (for engineering) • Developing and using models • Planning and carrying out investigations • Analyzing and interpreting data • Using mathematics and computational thinking • Constructing explanations (for science) and designing solutions (for engineering) • Engaging in argument from evidence • Obtaining, evaluating, and communicating information
<p>5. Incorporate History and Nature of Science</p> <p>NRC Framework: Praxis II (0481): IA</p>	<p>5.1 Ability to apply appropriate practices and knowledge to show scientific investigations use a variety of methods</p> <p>5.2 Ability to apply appropriate practices and knowledge to show scientific knowledge is based on empirical evidence</p> <p>5.3 Ability to apply appropriate practices and knowledge to show scientific knowledge is open to revision in light of new evidence</p> <p>5.4 Ability to apply appropriate practices and knowledge to scientific models, laws, mechanisms, and theories that explain natural phenomena</p> <p>5.5 Ability to apply appropriate practices and knowledge to show science is a way of knowing</p> <p>5.6 Ability to apply appropriate practices and knowledge to demonstrate scientific knowledge assumes an order and consistency in natural systems</p> <p>5.7 Ability to apply appropriate practices and knowledge to demonstrate science is a human endeavor</p> <p>5.8 Ability to demonstrate that science addresses questions about the natural and material world</p>
<p>6. Incorporate Mathematical Skills and Concepts related to physical science</p> <p>CCSS – Mathematics, grades 7-12 Praxis II (0481): IB</p>	<p>6.1 Ability to demonstrate proper knowledge and practice of appropriate arithmetic skills including percentage, fractions, decimals, ratios, and proportions</p> <p>6.2 Ability to demonstrate proper knowledge and practice of measurement skills including linear, volume, mass, and temperature using English and Metric Units</p> <p>6.3 Ability to demonstrate proper knowledge and practice of probability of an event occurring</p> <p>6.4 Ability to demonstrate proper knowledge and practice of algebraic skills including solving and graphing equations</p>

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	<p>6.5 Ability to demonstrate proper knowledge and practice of trigonometric functions to solve problems</p> <p>6.6 Ability to demonstrate proper knowledge and practice of scientific notation and significant digits</p>
<p>7. Incorporate Disciplinary Literacy</p> <p>CCSS - English/Language Arts: English Language Arts & Literacy in Science, and Technical Subjects, grades 7-12</p>	<p><u>Reading in Science and Technical Subjects, Grades 7-12</u></p> <p>Reading competencies for literacy in science and technical subjects for grades 7-12 include the ability to read informational texts in science and technical subjects closely and critically to analyze the key ideas and details as well as craft and structure with the purpose of integrating knowledge and ideas both within and across texts by</p> <p>7.1 Citing specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account</p> <p>7.2 Determining the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms</p> <p>7.3 Following precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyzing the specific results based on explanations in the text</p> <p>7.4 Determining the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 7-12 text and topics Analyzing how the text structures information or ideas are organized into categories or hierarchies, demonstrating understanding of the information or ideas</p> <p>7.5 Analyzing the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved</p> <p>7.6 Integrating and evaluating multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem</p> <p>7.7 Evaluating the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information</p> <p>7.8 Synthesizing information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible</p>

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	<p>7.9 Reading and comprehending a variety of scientific and technical documents appropriate for instruction within the 7-12 text complexity band</p> <p><u>Writing in History/Social Studies, Science, and Technical Subjects, Grades 7-12</u></p> <p>Writing competencies for literacy in history/social studies, science, and technical subjects for grades 7-12 will be demonstrated by</p> <p>7.10 Writing arguments focused on discipline-specific content by</p> <ol style="list-style-type: none"> a. Introducing precise, knowledgeable claim(s), establishing the significance of the claim(s), distinguishing the claim(s) from alternate or opposing claims, and creating an organization that logically sequences the claim(s), counterclaims, reasons, and evidence b. Developing claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience’s knowledge level, concerns, values, and possible biases. c. Using words, phrases, and clauses as well as varied syntax to link the major sections of the text, creating cohesion, and clarification of the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims. d. Establishing and maintaining a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. e. Providing a concluding statement or section that follows from or supports the argument presented <p>7.11 Writing informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes by</p> <ol style="list-style-type: none"> a. Introducing a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting(e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension b. Developing the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience’s knowledge of the topic c. Using varied transitions and sentence structures to link the major sections of the text, creating cohesion, and clarifying the relationships among complex ideas and concepts d. Using precise language, domain-specific vocabulary and
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	<p>techniques such as metaphor, simile, and analogy to manage the complexity of the topic; conveying a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers</p> <p>e. Providing a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic)</p> <p>7.12 Producing clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience</p> <p>7.13 Developing and strengthening writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience</p> <p>7.14 Using technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information</p> <p>7.15 Conducting short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation</p> <p>7.16 Gathering relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrating information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation</p> <p>7.17 Drawing evidence from informational texts to support analysis, reflection, and research</p> <p>7.18 Writing routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences</p>
<p>8. Incorporate Safety</p> <p>Praxis(0481): IIA</p>	<p>8.1 Ability to design activities in a grade 7-12 classroom that demonstrate the safe and proper techniques for the preparation, storage, dispensing, supervision, and disposal of all materials used within their subject area science instruction</p> <p>8.2 Ability to design and demonstrate activities in a grade 7-12 classroom that demonstrate an ability to implement emergency procedures and the maintenance of safety equipment, policies and procedures that comply with established state and/or national guidelines</p> <p>8.3 Ability to ensure safe science activities appropriate for the</p>

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	<p>abilities of all students</p> <p>8.4 Ability to design and demonstrate activities in a 7-12 classroom that demonstrate ethical decision-making with respect to the treatment of all living organisms in and out of the classroom</p> <p>8.5 Ability to emphasize safe, humane, and ethical treatment of animals and comply with the legal restrictions on the collection, keeping, and use of living organisms</p>
<p>9. Integration of STEM (science, technology, engineering, and mathematics)</p> <p>CCSS - English/Language Arts: English Language Arts & Literacy in Science, and Technical Subjects, grades 7-12</p> <p>CCSS – Mathematics, grades 7-12</p> <p>NRC Framework: Praxis II (0481): IC</p>	<p>9.1 Ability to understand and model key concepts of science, technology, engineering and mathematics (STEM)</p> <p>9.2 Ability to develop and deliver STEM-integrated, student-centered lessons and lab investigations taking into account factors such as safety measures, grades 7-12 classroom dynamics, problem solving, and project-based learning strategies, etc., which integrate grade-appropriate standards and practices</p> <p>9.3 Ability to understand and apply the engineering design process used to solve real-world problems in grades 7-12 lessons</p> <p>9.4 Ability to collect, evaluate, synthesize, and share real world data</p> <p>9.5 Ability to apply knowledge of STEM toward solving human and environmental problems</p> <p>9.6 Ability to utilize vocabulary, primary concepts, definitions, and models applicable to scientific investigations and engineering and design challenges</p> <p>9.7 Ability to develop and deliver STEM lesson assessments (formative and summative)</p> <p>9.8 Ability to recognize how an integrated approach can enrich the learning environment and build connections between STEM content areas</p> <p>9.9 Ability to appreciate the nature of science and scientific inquiry through solving real-world problems</p> <p>9.10 Ability to develop and implement grades 4-8 STEM units and lessons</p> <p>9.11 Ability to share, model, and practice strategies to support the integration of STEM areas with the emphasis in the 4-8 classroom</p>
<p>10. Incorporate Principles of Engineering Design, Technology, and Applications of Science</p> <p>CCSS - English/Language Arts: English Language Arts & Literacy in Science, and Technical Subjects, grades 7-12</p> <p>CCSS – Mathematics, grades 7-12</p>	<p>10.1 Ability to demonstrate a deep understanding following active investigations in the principles of the engineering design cycle in the context of grades 7-12 science including</p> <ul style="list-style-type: none"> • Defining and Delimiting an Engineering Problem • Developing Possible Solutions • Optimizing the Design Solution <p>10.2 Ability to demonstrate a deep understanding following active investigations in the principles of the links among engineering, technology, science, and society in the context of grades 7-12 science including</p>

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<p>NRC Framework: Praxis II (0481): IC</p>	<ul style="list-style-type: none"> • Interdependence of Science, Engineering, and Technology • Influence of Engineering, Technology, and Science on Society and the Natural World <p>10.3 Ability to display and apply proper knowledge and practices of personal and community health</p> <p>10.4 Ability to display and apply proper knowledge and practices of population growth</p> <p>10.5 Ability to display and apply proper knowledge and practices of natural resources</p> <p>10.6 Ability to display and apply proper knowledge and practices of environmental quality</p> <p>10.7 Ability to display and apply proper knowledge and practices of natural and human induced hazards</p> <p>10.8 Ability to display and apply proper knowledge and practices of science and technology and local, national, and global challenges</p>
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