

# Competencies for Middle Childhood Teachers: SCIENCE, Grades 4-8

2014

In addition to the Arkansas Teaching Standards, the teacher of middle school science, grades 4-8, shall demonstrate knowledge and competencies in the following areas:

<p><b>1. Integration of STEM (science, technology, engineering, and mathematics)</b></p> <p>CCSS - English/Language Arts: English Language Arts &amp; Literacy in Science, and Technical Subjects, grades 4-8</p> <p>CCSS – Mathematics, grades 4-8 NRC Framework</p>	<p>1.1 Ability to understand and model key concepts of science, technology, engineering, and mathematics (STEM)</p> <p>1.2 Ability to develop and deliver STEM-integrated, student-centered lessons and lab investigations taking into account factors such as safety measures, grades 4-8 classroom dynamics, problem solving, and project-based learning strategies, etc., which integrate grade-appropriate standards and practices</p> <p>1.3 Ability to understand and apply the engineering design process used to solve real-world problems in grades 4-8 lessons</p> <p>1.4 Ability to collect, evaluate, synthesize, and share real world data</p> <p>1.5 Ability to apply knowledge of STEM toward solving human and environmental problems</p> <p>1.6 Ability to utilize vocabulary, primary concepts, definitions, and models applicable to scientific investigations and engineering and design challenges</p> <p>1.7 Ability to develop and deliver STEM lesson assessments (formative and summative)</p> <p>1.8 Ability to recognize how an integrated approach can enrich the learning environment and build connections between STEM content areas</p> <p>1.9 Ability to appreciate the nature of science and scientific inquiry through solving real-world problems</p> <p>1.10 Ability to develop and implement grades 4-8 STEM units and lessons</p> <p>1.11 Ability to share, model, and practice strategies to support the integration of STEM areas with the emphasis in the 4-8 classroom</p>
<p><b>2. Vision for K-12 science education: scientific and engineering practices, cross cutting concepts, and core ideas</b></p> <p>CCSS - English/Language Arts: English Language Arts &amp; Literacy in Science, and Technical Subjects, grades 4-8</p> <p>CCSS – Mathematics, grades 4-8 NRC Framework</p>	<p>2.1 Ability to demonstrate a command of the vision for K-12 science education- "... students, over multiple years of school, actively engage in scientific and engineering practices and apply crosscutting concepts to deepen their understanding of the core ideas in these fields."</p> <p>2.2 Ability to demonstrate a command of the eight scientific and engineering practices identified in the NRC Framework listed below:</p> <ul style="list-style-type: none"> <li>• Asking questions (for science) and defining problems (for engineering)</li> <li>• Developing and using models</li> <li>• Planning and carrying out investigations</li> </ul>

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	<ul style="list-style-type: none"> <li>• Analyzing and interpreting data</li> <li>• Using mathematics and computational thinking</li> <li>• Constructing explanations (for science) and designing solutions (for engineering)</li> <li>• Engaging in argument from evidence</li> <li>• Obtaining, evaluating, and communicating information</li> </ul> <p>2.3 Ability to demonstrate understanding through the application of the seven crosscutting concepts that should be reinforced by repeated use in instruction across the disciplinary core ideas with</p> <ul style="list-style-type: none"> <li>• Patterns</li> <li>• Cause and effect: Mechanism and explanation</li> <li>• Scale, proportion, and quantity</li> <li>• Systems and system models</li> <li>• Energy and matter: flows, cycles, and conservation</li> <li>• Structure and function</li> <li>• Stability and change</li> </ul> <p>2.4 Ability to demonstrate understanding of the disciplinary core ideas in physical sciences, life sciences, and earth and space sciences as detailed in the NRC Framework</p> <p>2.5 Ability to identify and implement lessons/units that integrate the scientific and engineering practices and crosscutting concepts with each of the core ideas as specified in the performance expectations of the NRC Framework</p> <p>2.6 Ability to demonstrate content and science investigation teaching methods for grades 4-8 in the particular core ideas of:</p> <p><u>Physical Sciences</u></p> <p>PS 1: Matter and its interactions          PS 2: Motion and stability: Forces and interactions          PS 3: Energy          PS 4: Waves and their applications in technologies for information transfer</p> <p><u>Life Sciences</u></p> <p>LS 1: From molecules to organisms: Structures and processes          LS 2: Ecosystems: Interactions, energy, and dynamics          LS 3: Heredity: Inheritance and variation of traits          LS 4: Biological evolution: Unity and diversity</p> <p><u>Earth and Space Sciences</u></p> <p>ESS 1: Earth’s place in the universe          ESS 2: Earth’s systems          ESS 3: Earth and human activity</p> <p><u>Engineering, Technology, and the Applications of Science</u></p> <p>ETS 1: Engineering design</p>
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	<p>ETS 2: Links among engineering, technology, science, and society</p> <p>2.7 Ability to demonstrate a command of the implementation of the Common Core State Standards for math and English/language arts and ISTE Standards for Teachers as they support the NRC Framework</p> <p>2.8 Ability to design and conduct science investigations in at least one, if not all, of the disciplinary core ideas with attention to gathering and interpreting scientific data</p> <p>2.9 Ability to demonstrate diverse teaching strategies for reading and writing informational texts like those read and written by scientists</p>
<p><b>3. Principles of Life Sciences</b></p> <p>CCSS - English/Language Arts: English Language Arts &amp; Literacy in Science, and Technical Subjects, grades 4-8</p> <p>CCSS – Mathematics, grades 4-8</p> <p>NRC Framework</p>	<p>3.0 Ability to demonstrate a deep understanding following active investigations of molecules to organisms including</p> <ul style="list-style-type: none"> <li>• Structure and Function</li> <li>• Growth and Development of Organisms</li> <li>• Organization for Matter and Energy Flow in Organisms</li> <li>• Information Processing</li> </ul> <p>3.1 Ability to demonstrate a deep understanding following active investigations of ecosystems including</p> <ul style="list-style-type: none"> <li>• Interdependent Relationships in Ecosystems</li> <li>• Cycles of Matter and Energy Transfer in Ecosystems</li> <li>• Ecosystem Dynamics, Functioning, and Resilience</li> <li>• Social Interactions and Group Behavior</li> </ul> <p>3.2 Ability to demonstrate a deep understanding following active investigations of heredity including</p> <ul style="list-style-type: none"> <li>• Inheritance of Traits</li> <li>• Variation of Traits</li> </ul> <p>3.3 Ability to demonstrate a deep understanding following active investigations of biological evolution including</p> <ul style="list-style-type: none"> <li>• Evidence of Common Ancestry and Diversity</li> <li>• Natural Selection</li> <li>• Adaptation</li> <li>• Biodiversity and Humans</li> </ul>
<p><b>4. Principles of Physical Sciences</b></p> <p>CCSS - English/Language Arts: English Language Arts &amp; Literacy in Science, and Technical Subjects, grades 4-8</p> <p>CCSS – Mathematics, grades 4-8</p> <p>NRC Framework</p>	<p>4.1 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"> <li>• Structure and Properties of Matter</li> <li>• Chemical Reactions</li> <li>• Nuclear Processes</li> </ul> <p>4.2 Ability to demonstrate a deep understanding following active investigations of motion and stability including</p> <ul style="list-style-type: none"> <li>• Forces and Motion</li> <li>• Types of Interactions</li> <li>• Stability and Instability in Physical Systems</li> </ul> <p>4.3 Ability to demonstrate a deep understanding following active</p>

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	<ul style="list-style-type: none"> <li>investigations of energy including               <ul style="list-style-type: none"> <li>• Definitions of Energy</li> <li>• Conservation of Energy and Energy Transfer</li> <li>• Relationship Between Energy and Forces</li> <li>• Energy in Chemical Processes and Everyday Life</li> </ul> </li> <li>4.4 Ability to demonstrate a deep understanding following active investigations of waves and their applications in technologies for information transfer including               <ul style="list-style-type: none"> <li>• Wave Properties</li> <li>• Electromagnetic Radiation</li> <li>• Information Technologies and Instrumentation</li> </ul> </li> </ul>
<p><b>5. Principles of Earth and Space Sciences</b></p> <p>CCSS - English/Language Arts: English Language Arts &amp; Literacy in Science, and Technical Subjects, grades 4-8</p> <p>CCSS – Mathematics, grades 4-8</p> <p>NRC Framework</p>	<ul style="list-style-type: none"> <li>5.0 Ability to demonstrate a deep understanding following active investigations in the principle of Earth’s place in the universe including               <ul style="list-style-type: none"> <li>• The Universe and Its Stars</li> <li>• Earth and the Solar System</li> <li>• The History of Planet Earth</li> </ul> </li> <li>5.1 Ability to demonstrate a deep understanding following active investigations in the principle of Earth’s systems including               <ul style="list-style-type: none"> <li>• Earth Materials and Systems</li> <li>• Plate Tectonics and Large-Scale System Interactions</li> <li>• The Roles of Water in Earth’s Surface Processes</li> <li>• Weather and Climate</li> <li>• Biogeology</li> </ul> </li> <li>5.2 Ability to demonstrate a deep understanding following active investigations in the principle of Earth and human activity including               <ul style="list-style-type: none"> <li>• Natural Resources</li> <li>• Natural Hazards</li> <li>• Human Impacts on Earth Systems</li> <li>• Global Climate Change</li> </ul> </li> </ul>
<p><b>6. Principles of Engineering Design, Technology, and Applications of Science</b></p> <p>CCSS - English/Language Arts: English Language Arts &amp; Literacy in Science, and Technical Subjects, grades 4-8</p> <p>CCSS – Mathematics, grades 4-8</p> <p>NRC Framework</p>	<ul style="list-style-type: none"> <li>6.0 Ability to demonstrate a deep understanding following active investigations in the principles of the engineering design cycle in the context of grades 4-8 science including               <ul style="list-style-type: none"> <li>• Defining and Delimiting an Engineering Problem</li> <li>• Developing Possible Solutions</li> <li>• Optimizing the Design Solution</li> </ul> </li> <li>6.1 Ability to demonstrate a deep understanding following active investigations in the principles of links among engineering, technology, science, and society in the context of grades 4-8 science including               <ul style="list-style-type: none"> <li>• Interdependence of Science, Engineering, and Technology</li> <li>• Influence of Engineering, Technology, and Science on Society and the Natural World</li> </ul> </li> </ul>

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<p><b>7. Safety</b> NRC Framework</p>	<p>7.1 Ability to design activities in a grade 4-8 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>7.2 Ability to design and demonstrate activities in a grade 4-8 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>7.3 Ability to ensure safe science activities appropriate for the abilities of all students</p> <p>7.4 Ability to design and demonstrate activities in a 4-8 classroom that demonstrate ethical decision-making with respect to the treatment of all living organisms in and out of the classroom</p> <p>7.5 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><b>8. Disciplinary Literacy*</b> ACEI: 2.1 CCSS-ELA: RI.K-5.1-10; RH.6.1-10; RST.6.1-10; W.K-6.1-10; WHST.6.1-10</p>	<p><u>Reading in Science and Technical Subjects, Grades 6-8</u> Reading competencies for literacy in science and technical subjects for grades 6-8 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>8.1 Knowing developmentally appropriate scientific and technical texts across genres, cultures, and centuries</p> <p>8.2 Selecting developmentally appropriate scientific and technical texts, using all measures of text complexity: qualitative, quantitative, and reader and task</p> <p>8.3 Reading scientific and technical texts 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> <ul style="list-style-type: none"> <li>• Citing specific textual evidence to support analysis of science and technical texts</li> <li>• Determining the central ideas or conclusions of a text; providing an accurate summary of the text distinct from prior knowledge or opinions</li> <li>• Following precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks</li> <li>• 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</li> <li>• Analyzing the structure an author uses to organize a text,</li> </ul>

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	<p>including how the major sections contribute to the whole and to an understanding of the topic</p> <ul style="list-style-type: none"> <li>• Analyzing the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text</li> <li>• Integrating quantitative or technical information expressed in words in a text with a version of that information expressed visually</li> <li>• Distinguishing among facts, reasoned judgment based on research findings, and speculation in a text</li> </ul> <p>8.4 Comparing and contrasting the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic</p> <p><u>Writing in History/Social Studies, Science, and Technical Subjects, Grades 6-8</u></p> <p>Writing competencies for literacy in history/social studies, science, and technical subjects for grades 6-8 will be demonstrated by</p> <p>8.5 Writing opinion pieces on topics or texts, supporting a point of view with reasons and information by</p> <ul style="list-style-type: none"> <li>• Introducing a topic or text clearly, stating an opinion, and creating an organizational structure in which ideas are logically grouped to support the writer’s purpose</li> <li>• Providing logically ordered reasons that are supported by facts and details</li> <li>• Linking opinion and reasons using words, phrases, and clauses</li> <li>• Providing a concluding statement or section related to the opinion presented</li> </ul> <p>8.6 Writing arguments focused on discipline-specific content by</p> <ul style="list-style-type: none"> <li>• Introducing claim(s) about a topic or issue, acknowledging and distinguishing the claim(s) from alternate or opposing claims, and organizing the reasons and evidence logically</li> <li>• Supporting claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources</li> <li>• Using words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence</li> <li>• Establishing and maintaining a formal style</li> <li>• Providing a concluding statement or section that follows</li> </ul>
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	<p>from and supports the argument presented</p> <p>8.7 Writing informative/explanatory texts, including the narration of historical events, scientific procedures/experiments or technical processes by</p> <ul style="list-style-type: none"> <li>• Introducing a topic clearly and previewing what is to follow             <ul style="list-style-type: none"> <li>○ Organizing ideas, concepts, and information into broader categories as appropriate to achieving purpose</li> <li>○ Including formatting, graphics, and multimedia when useful to aiding comprehension</li> </ul> </li> <li>• Developing the topic with relevant, well-chosen facts, definitions, concrete details, quotations, or other information and examples</li> <li>• Using appropriate and varied transitions to create cohesion and clarifying the relationships among ideas and concepts</li> <li>• Using precise language and domain-specific vocabulary to inform about or explain the topic</li> <li>• Establishing and maintaining a formal style and objective tone</li> <li>• Providing a concluding statement or section that follows from and supports the information or explanation presented</li> </ul> <p>8.8 Incorporating narrative elements effectively into arguments and informative/explanatory texts by</p> <ul style="list-style-type: none"> <li>• Incorporating narrative accounts into analyses of individuals or events of historical import</li> <li>• Writing precise enough descriptions of the step-by-step procedures used in scientific investigations or technical work so that others can replicate them and (possibly) reach the same results</li> </ul> <p>8.9 Producing and distributing writing by</p> <ul style="list-style-type: none"> <li>• Producing clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience</li> <li>• Developing and strengthening writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on how well purpose and audience have been addressed</li> <li>• Demonstrating a command of Standard grammar and conventions</li> </ul> <p>8.10 Demonstrating the grade-level expectations for using technology by</p>
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	<ul style="list-style-type: none"> <li>• Using the Internet to produce and publish writing as well as to collaborate with others</li> <li>• Presenting the relationships between information and ideas clearly and efficiently</li> </ul> <p>8.11 Using research to build and present knowledge by</p> <ul style="list-style-type: none"> <li>• Conducting short research projects to answer a question (including a self-generated question)             <ul style="list-style-type: none"> <li>○ Drawing on several sources</li> <li>○ Generating additional related, focused questions that allow for multiple avenues of exploration</li> </ul> </li> <li>• Gathering relevant information from multiple print and digital sources             <ul style="list-style-type: none"> <li>○ Using search terms effectively</li> <li>○ Assessing the credibility and accuracy of each source</li> <li>○ Quoting or paraphrasing the data and conclusions of others</li> <li>○ Avoiding plagiarism</li> <li>○ Following a standard format for citation</li> </ul> </li> <li>• Drawing evidence from informational texts to support analysis, reflection, and research</li> </ul>
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**\*Disciplinary Literacy Competencies for K-6 and 4-8**

Based on the CCSS, the Disciplinary Literacy Competencies for K-5 address all content areas across the Reading Informational and Writing strands. The competencies for grades 6-8 are presented in one grade band that is divided as follows: Reading in History/Social Studies, Reading in Science and Technical Subjects, and Writing in History/Social Studies, Science, and Technical Subjects.