Competencies for Secondary Teachers: Physics/Math, Grades 7-12

2021

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

1. Content Knowledge *NSTA/ASTE: Standard 1* *NRC Framework* *Praxis (5265)* *AAPT* *AR SS* *AR K-12 Science Standards*	***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 7-12 students ***NRC Framework: Core Component Ideas in the Physical Sciences:*** 1.4 Core Idea PS1: Matter and Its Interactions PS1.A: Structure and Properties of Matter PS1.B: Chemical Reactions PS1.C: Nuclear Processes *Key concepts: Coulomb's Law, Nuclear Physics, Properties of Design Material, and Nature of Atomic and Subatomic Structure* 1.5 Core Idea PS2: Motion and Stability: Forces and Interactions PS2.A: Forces and Motion PS2.B: Types of Interaction PS.2C: Stability and Instability in Physical Systems *Key concepts: Newton's Laws, Kinematics, Impulse=Change in Momentum, Conservation of Energy, Uni. Gravitation,*

	Coulomb's Law, Current, Magnetism, and Induction, Vectors and Scalars, Dynamics, and Fluid Mechanics 1.6 Core Idea PS3: Energy PS3.A: Definitions of Energy PS3.B: Conservation of Energy and Energy Transfer PS3.C: Relationship Between Energy and Forces PS3.D: Energy in Chemical Processes and Everyday Life *Key concepts include: Forms of Energy, Conservation of Energy, Magnetic Fields, Thermodynamics, and Electromagnetic Fields* 1.7 Core Idea PS4: Waves and Their Applications in Technologies for Information Transfer PS4.A: Wave Properties PS4.B: Electromagnetic Radiation PS4.C: Information Technologies and Instrumentation *Key concepts include: Waves, Refraction, Information Technology, Wave-Particle Duality, Photoelectric Eff., Absorption, Optics, Longitudinal Waves, Simple Harmonic Motion, and E&M Waves*
2. Content Pedagogy *NSTA/ASTE: Standard 2* *AAPT*	***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 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 for Speakers of Other Languages (ESOL) 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. 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 environment to achieve these goals* 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 (5265)* *COSSS*	***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 chemicals/materials/equipment used within their fields of licensure 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
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 Promotes respect for students' differences 6.5 Collaborates with families and the local community
7. Incorporates Crosscutting Concepts *NRC Framework* *Praxis (5265)*	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 paired with the disciplinary core ideas and science and engineering practices
8. Incorporates Science and Engineering Practices *NRC Framework* *Praxis (5265)*	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 paired with the disciplinary core ideas and the crosscutting concepts
9. Incorporates History and Nature of Science *NRC Framework* *Praxis (5265)* *VI. Scientific Inquiry, Processes, and Social Perspectives*	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* *AR SS*	10.1 Engages students in active scientific 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 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
11. Supporting Competencies *NSTA-P* *NRC Framework* *AR SS*	*11.1* *<u>Mathematics:</u>* ● Understands how mathematical and statistical models evaluate the strength of a conclusion ● Understands how mathematical models are used in physics ● Understands what are the applications of calculus and differential equations in physics ● Understands how to use logarithms, trigonometric functions, Pythagorean theorem, vector resolution and addition

	11.2 *Chemistry* ● Understands what is matter ● Understands nature of atomic and subatomic structure, including atomic models ● Understands nuclear chemistry ● Knows what trends exist in the Periodic Table and how do those trends reflect atomic structure ● Understands in what ways do atoms combine to form novel substances ● Understands relationship of atomic spectra to electron energy levels *11.3* *Earth and Space Sciences* ● Understands what are the predictable patterns caused by Earth's motion in the Solar System *11.4* *Engineering, Technology and Applications* ● Understands that the engineering design process begins with identifying a problem and developing clear goals that the final product or system must meet ● Understands the process for developing potential design solutions, including models or prototypes ● Understands how to compare and improve various proposed design solutions
12. Scientific Procedures and Techniques *Praxis (5265)* *Section: 6.B.*	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) 12.2 Understands basic error analysis ● Determining mean ● Accuracy and precision ● Identifying sources and effects of error and its impact on percent error
13. Knowing and Understanding Mathematics *NCTM/CAEP:* *Standard 1* *Praxis (5161): Sections I & II* *AR Algebra I, II, & III Standards* *AR Calculus Standards* *AR Geometry Standards* *AR Statistics Standards* *AR Quantitative Literacy Standards*	***NCTM/CAEP Standard 1:*** *Demonstrate and apply understandings of major mathematics concepts, procedures, knowledge, and applications within and among mathematical domains of: Number; Algebra and Functions; Calculus; Statistics and Probability; Geometry, Trigonometry and Measurement* *Arkansas teachers should exhibit knowledge and understanding of the essential concepts in each mathematical domain. Additional, specific competencies from Praxis content knowledge test specifications and Arkansas Standards are included. The intention of this is to augment and provide additional detail to the essential concepts.* 13.1 **Essential Concepts in Number-** Demonstrate and apply understandings of major mathematics concepts, procedures, knowledge, and applications of number including flexibly applying procedures, using real and rational numbers in contexts, developing solution strategies, and evaluating the correctness of conclusion. Major mathematical concepts in *Number* include number systems (particularly rational numbers); algorithmic and recursive thinking; number and set theory; ratio, rate of change, and proportional reasoning; and structure, relationships, operations, and representations *Additional specific competencies in Number required for Arkansas teachers include*:

	a) Understand the structure of the natural, integer, rational, real, and complex number systems and how basic operations on numbers in these systems are performed b) Understand and apply the properties of exponents, including working with rational exponents and radicals c) Reason quantitatively and use understanding of units to solve problems (e.g., dimensional analysis, reasonableness of solutions) d) Understand how to solve problems involving ratios, proportions, averages, percents, and metric and traditional unit conversions e) Understand how to perform operations on matrices and apply matrices to solve problems, including in programming applications f) Represent and compare very large and very small numbers (e.g., scientific notation, orders of magnitude) and estimate and perform calculations on these numbers g) Use number sense and proportional reasoning in real world settings to make and communicate decisions in quantitative analysis h) Understand how to use counting techniques such as the multiplication principle, permutations, and combinations i) Understand basic set theory (e.g., unions, differences, Venn diagrams) j) Understand the differences between discrete and continuous representations (e.g., data, functions) and how each can be used to model various phenomena 13.2 **Essential Concepts in Algebra and Functions**- Demonstrate and apply understandings of major mathematics concepts, procedures, knowledge, and applications of algebra and functions including how mathematics can be used systematically to represent patterns and relationships including proportional reasoning, to analyze change, and to model everyday events and problems of life and society. Essential Concepts in *Algebra and Functions* include algebra that connects mathematical structure to symbolic, graphical, and tabular descriptions; connecting algebra to functions; and developing families of functions as a fundamental concept of

	mathematics. Advanced concepts should include algebra from a more theoretical approach including relationship between structures (e.g., groups, rings, and fields) as well as formal structures for number systems and numerical and symbolic calculations. Rewrite algebraic expressions in equivalent forms and choose the appropriate form of an algebraic expression for a given purpose *Additional specific competencies in Algebra required for Arkansas teachers include:* a) Understand how to perform arithmetic operations on polynomials and rational expressions b) Understand and utilize the relationship between zeros of polynomial functions (including non-real complex zeros and graphical representations of real zeros) and factors of the related polynomial expressions c) Understand how to use polynomial identities (e.g., difference of squares, sum and difference of cubes) to solve problems d) Use equations and inequalities to describe relationships e) Justify the reasoning process used to solve equations, including analysis of potential extraneous solutions f) Use varied techniques (e.g., graphical, algebraic) to solve equations and inequalities in one variable g) Understand how varied techniques (e.g., graphical, algebraic, matrix) are used to solve systems of equations and inequalities h) Understand the concept of average rate of change over an interval for nonlinear functions and utilize it in problem-solving contexts i) Recognize, extract, and interpret information about a linear equation presented in various forms (e.g., slope-intercept, point-slope, standard), including within a modeling context

	j) Understand sequences and define them recursively (e.g., arithmetic, geometric) *Additional specific competencies in Functions required for Arkansas teachers include:* a) Understand the function concept and the use of function notation b) Understand how to find the domain and range of a function and a relation c) Analyze function behavior using different representations (e.g., graphs, mappings, tables, recursively-defined functions) d) Understand how to find and interpret the zero(s) of functions e) Understand how functions and relations are used to model relationships between quantities f) Understand how new functions are obtained from existing functions (e.g., compositions, transformations, inverses) g) Understand differences between linear, quadratic, and exponential models, including how their equations are created and used to solve problems h) Understand the relationship between points on the unit circle and the values of trigonometric functions for any given angle measure i) Understand how periodic phenomena are modeled using trigonometric functions j) Understand the derivation and application of trigonometric identities (e.g., Pythagorean, double angle, half angle, sum of angles, difference of angles) k) Understand how to interpret representations of functions of two variables (e.g., three-dimensional graphs, tables) l) Understand how to solve trigonometric, logarithmic, and exponential equations m) Apply knowledge of functions and equations in programming applications

	13.3 **Essential Concepts in Calculus.** Demonstrate and apply understandings of major mathematics concepts, procedures, knowledge, and applications of calculus including the mathematical study of the calculation of instantaneous rates of change and the summation of infinitely many small factors to determine some whole. Essential Concepts in *Calculus* include limits, continuity, the Fundamental Theorem of Calculus, and the meaning and techniques of differentiation and integration. *Additional specific competencies in Calculus required for Arkansas teachers include:* a) Understand the meaning of a limit of a function and how to calculate limits of functions, conditions when the limit does not exist, and solve problems using the properties of limits b) Understand the derivative of a function as a limit, as the slope of a line tangent to a curve, and as a rate of change c) Understand what it means that a particular function is continuous at a given point d) Know the relationship between continuity and differentiability e) Understand how and when to use standard differentiation and integration techniques f) Understand how to analyze the behavior of a function (e.g., extrema, concavity, symmetry) g) Understanding how to apply derivatives to solve problems both theoretically and in a real-world context (e.g., related rates, optimization) h) Understand the foundational theorems of calculus (e.g., fundamental theorems of calculus, mean value theorem, intermediate value theorem) i) Understand integration as a limit of Riemann sums to compute area, volume, distance, or other accumulation processes

	j) Know how to determine the limits of sequences, if they exist 13.4 **Essential Concepts in Statistics and Probability**. Demonstrate and apply understandings of statistical thinking and the major concepts, procedures, knowledge, and applications of statistics and probability, including how statistical problem solving and decision making depend on understanding, explaining, and quantifying the variability in a set of data to make decisions and understanding the role of randomization and chance in determining the probability of events. Essential Concepts in *Statistics and Probability* include quantitative literacy, visualizing and summarizing data, statistical inference, probability, and applied problems *Additional specific competencies in Statistics and Probability required for Arkansas teachers include:* a) Understand how to summarize, represent, and interpret data collected from measurements on a single variable (e.g., box plots, dot plots, normal distributions) b) Understand how to summarize, represent, and interpret data collected from measurements on two variables, either categorical or quantitative (e.g., scatterplots, time series) c) Understand how to create and interpret linear regression models (e.g., rate of change, intercepts, correlation coefficient) d) Understand how to make inferences and justify conclusions from samples, experiments, and observational studies e) Understand the concept of independence and understand how to compute probabilities of simple events, probabilities of compound events, and conditional probabilities f) Know how to make informed decisions using probabilities and expected values

	g) Understand how to find probabilities involving finite sample spaces and independent trials, including the use of the counting techniques (e.g., fundamental counting principles, permutations, combinations) h) Understand normal distributions i) Using statistical and probabilistic reasoning to draw conclusions, to make decisions, and to evaluate outcomes of decision 13.5 **Essential Concepts in Geometry, Trigonometry, and Measurement.** Demonstrate and apply understandings of major mathematics concepts, procedures, knowledge, and applications of geometry, including using visual representations for numerical functions and relations, data and statistics, and networks, to provide a lens for solving problems in the physical world. Essential Concepts in *Geometry, Trigonometry, and Measurement* include transformations, geometric arguments, reasoning and proof, applied problems, and non-Euclidean geometries *Additional specific competencies in Geometry required for Arkansas teachers include*: a) Know the properties of lines (e.g., parallel, perpendicular, intersecting) and angles b) Know and apply properties of triangles, quadrilaterals (e.g., parallelogram, rectangle, rhombus) and other polygons c) Understand and investigate transformations in the plane and apply their properties d) Understand congruence and similarity, including congruence and similarity theorems and use of transformations to define congruence and similarity e) Know how to prove geometric theorems, such as those about lines and angles, triangles, and parallelograms

	f) Understand how geometric constructions are made with a variety of tools and methods g) Understanding how trigonometry is applied to triangles, including the definition of trigonometric functions in right triangles h) Understand and apply theorems about circles i) Find arc length and area measurements of sectors of circles j) Know how to translate between a geometric description (e.g., focus, asymptotes, directrix) and an equation for a conic section k) Understand how to represent geometric objects in coordinate geometry to algebraically prove simple geometric theorems l) Use perimeter, area, surface area, and volume formulas to solve problems m) Know how to visualize relationships (e.g., cross section, nets, rotations) between two-dimensional and three-dimensional objects n) Apply geometric concepts in modeling and real world situations
14. Knowing and Using Mathematical Processes *NCTM/CAEP:* *Standard 2* *NCTM-MP*	***NCTM/CAEP Standard 2:*** *Demonstrate, within or across mathematical domains, their knowledge of and ability to apply the mathematical processes of problem solving; reason and communicate mathematically; and engage in mathematical modeling. Apply technology appropriately within these mathematical processes* 14.1 Demonstrate a range of mathematical problem-solving strategies to make sense of and solve non-routine problems (both contextual and non-contextual) across mathematical domains 14.2 Organize mathematical reasoning and use the language of mathematics to express mathematical reasoning precisely, both orally and in writing, to multiple audiences 14.3 Understand the difference between the mathematical modeling process and models in mathematics; engage in the mathematical modeling process and demonstrate ability to model mathematics

	NCTM-MP: *The Standards for Mathematical Practices describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. These practices rest on important "processes and proficiencies" with longstanding importance in mathematics education.* ❖ Make sense of problems and persevere in solving them ❖ Reason abstractly and quantitatively ❖ Construct viable arguments and the critique the reasoning of others ❖ Model with mathematics ❖ Use appropriate tools strategically ❖ Attend to precision ❖ Look for and make use of structure ❖ Look for and express regularity in repeated reasoning 14.4 Understand the importance of providing students with opportunities to learn mathematics that enable them to think analytically and creatively for everyday problem-solving and preparation for the workforce, college, citizenship, and life

15. Knowing Students and Planning for Mathematical Learning *NCTM/CAEP:* *Standard 3*	***NCTM/CAEP Standard 3:*** *Apply knowledge of students and mathematics to plan rigorous and engaging mathematics instruction supporting students' access and learning, and develop mathematics instruction that provides equitable, culturally responsive opportunities for all students to learn and apply mathematics concepts, skills, and practices* 15.1 Identify and use students' individual and group differences to plan rigorous and engaging mathematics instruction that supports students' meaningful participation and learning 15.2 Identify and use students' mathematical strengths to plan rigorous and engaging mathematics instruction that supports students' meaningful participation and learning 15.3 Understand that teachers' interactions impact individual students by influencing and reinforcing students' mathematical identities, positive or negative, and plan experiences and instruction to develop and foster positive mathematical identities
16. Teaching Meaningful Mathematics *NCTM/CAEP:* *Standard 4* *NCTM-PA*	***NCTM/CAEP Standard 4:*** *Implement effective and equitable teaching practices to support rigorous mathematical learning for a full range of students. Establish rigorous mathematics learning goals, engage students in high cognitive demand learning, use mathematics specific tools and representations, elicit and use student responses, develop conceptual understanding and procedural fluency, and pose purposeful questions to facilitate student discourse* 16.1 Establish rigorous mathematics learning goals for students based on mathematics standards and practices 16.2 Select or develop and implement high cognitive demand tasks to engage students in mathematical learning experiences that promote reasoning and sense making

	16.3 Select mathematics-specific tools, including technology, to support students' learning, understanding, and application of mathematics and to integrate tools into instruction 16.4 Select and use mathematical representations to engage students in examining understandings of mathematics concepts and the connections to other representations 16.5 Use multiple student responses, potential challenges, and misconceptions, and they highlight students' thinking as a central aspect of mathematics teaching and learning 16.6 Use conceptual understanding to build procedural fluency for students through instruction that includes explicit connections between concepts and procedures 16.7 Pose purposeful questions to facilitate discourse among students that ensures that each student learns rigorous mathematics and builds a shared understanding of mathematical ideas
17. Assessing Impact on Student Learning *NCTM/CAEP:* *Standard 5*	**NCTM/CAEP Standard 5:** *Assess and use evidence of students' learning of rigorous mathematics to improve instruction and subsequent student learning. Analyze learning gains from formal and informal assessments for individual students, the class as a whole, and subgroups of students disaggregated by demographic categories, and they use this information to inform planning and teaching* 17.1 Select, modify, or create both informal and formal assessments to elicit information on students' progress toward rigorous mathematics learning goals 17.2 Collect information on students' progress and use data from informal and formal assessments to analyze progress of individual students, the class as a whole, and subgroups of students disaggregated by demographic categories toward rigorous mathematics learning goals

	17.3 Use the evidence of student learning of individual students, the class as a whole, and subgroups of students disaggregated by demographic categories to analyze the effectiveness of their instruction with respect to these groups. Propose adjustments to instruction to improve student learning for each and every student based on the analysis
18. Social and Professional Context of Mathematics Teaching and Learning *NCTM/CAEP:* *Standard 6*	**NCTM/CAEP Standard 6:** *Aspire to become reflective mathematics educators who collaborate with colleagues and other stakeholders to grow professionally, to support student learning, and to create more equitable mathematics learning environments* 18.1 Seek to create more equitable learning environments about teaching and learning mathematics, and associated classroom practices that produce equitable or inequitable mathematical learning for students 18.2 Reflect on their impact on students' mathematical identities and develop professional learning goals that promote students' positive mathematical identities 18.3 Communicate with families to share and discuss strategies for ensuring the mathematical success of their children 18.4 Collaborate with colleagues to grow professionally and support student learning of mathematics
19. Disciplinary Literacy *AR DLS*	***Reading Standards for Literacy in Science and Technical Subjects.*** ***Grades 9-12*** 19.1 Reads science/technical texts closely to determine what the text says explicitly and to make logical inferences from it, while determining central ideas or themes and analyzing development by • Cites specific textual evidence to support analysis of science and technical sources, attending to such features as the date and origin of the information [Grades 9-10]; and cites 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 [Grades 11-12] ● Determines the central ideas or conclusions of a text; traces the text's explanation or depiction of a complex process, phenomenon, or concept; provides an accurate summary of the text [Grades 9-10]; and determines the central ideas or conclusions of a text; summarizes complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms [Grades 11-12] ● Follows precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text [Grades 9-10]; and follows precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyzes the specific results based on explanations in the text [Grades 11-12] 19.2 Interprets words and phrases as they are used in a historical/social studies texts, while analyzing the structure of such texts ● Determines 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 grade-specific texts and topics [Grades 9-12] ● Analyzes the structure of the relationships among concepts in a text, including relationships among key terms [Grades 9-10]; and analyzes how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas [Grades 11-12] ● Analyzes the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address

	[Grades 9-10]; and analyzes the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved [Grades 11-12] 19.3 Integrates knowledge and ideas ● Translates quantitative or technical information expressed in words in a text into visual form (e.g., a table chart) and translate information expressed visually or mathematically (e.g., in an equation) into words [Grades 9-10]; and integrates and evaluate 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 [Grades 11-12] ● Assesses the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem [Grades 9-10]; and evaluates 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 [Grades 11-12] ● Compares and contrasts findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts [Grades 9-10]; and synthesizes 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 [Grades 11-12] 19.4 Reads and comprehends science/technical texts in the Grades 9–10 text complexity band independently and proficiently by the end of Grade 10; reads and comprehends science/technical texts in

	the Grades 11–12 text complexity band independently and proficiently by the end of Grade 12 ***Writing Standards for Literacy in Science and Technical Subjects, Grade 9-12*** 19.5 Writes arguments to support claims when analyzing substantive topics or texts using valid reasoning and relevant, sufficient evidence; writes informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective; and writes narratives to develop real or imagined experiences or events using effective technique, well-chosen details and well-structured event sequences ● Writes arguments focused on discipline-specific content [Grades 9-12] ● Introduces precise claim(s), distinguishes the claim(s) from alternate or opposing claims, and creates an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence [Grades 9-10]; and introduces precise, knowledgeable claim(s), establishes the significance of the claim(s), distinguishes the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence [Grades 11-12] ● Develops claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience's knowledge level and concerns [Grades 9-10]; and develops 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 [Grades 11-12] ● Uses words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims [Grades 9-10]; and uses words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims [Grades 11-12] 19.6 Produces and distributes writing ● Establishes and maintains a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing [Grades 9-10]; and establishes and maintains a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing [Grades 11-12] ● Provides a concluding statement or section that follows from or supports the argument presented [Grades 9-12] ● Writes informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes [Grades 9-12] ● Introduces a topic and organize ideas, concepts, and information to make important connections and distinctions; includes formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension [Grades 9-10]; and introduces a topic and organizes 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 [Grades 11-12]

	• Develops the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic [Grades 9-10]; and develops 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 [Grades 11-12] 19.7 Uses research to build and present knowledge: • Conducts short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration [Grades 9-12] • Gathers relevant information from multiple print and digital sources, using search terms effectively; assessing the credibility and accuracy of each source; quoting or paraphrasing the data and conclusions of other while avoiding plagiarism and following a standard format for citation [Grades 9-12] • Draws evidence from information to support analysis, reflection, and research [Grades 9-12] 19.8 Writes 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 [Grades 9-12]
20. DESE GUIDE for Life *GUIDE for Life*	***GUIDE for Life*** *The Arkansas Department of Education has identified five guiding principles that support educators in their efforts to help all students develop these critical skills. Each principle represents a set of skills needed to thrive at home, school, on the job and in the community. These guiding principles are:*

	20.1 Growth (manages self) • Develops problem-solving skills • Practices mindfulness • Perseveres 20.2 Understanding (knows self) • Increases self-awareness • Knows own strengths and weaknesses • Develops critical thinking skills 20.3 Interaction (builds relationships) • Treats others with respect • Communicates effectively • Seeks out and offers help when needed 20.4 Decisions (makes responsible choices) • Considers personal beliefs • Thinks through potential consequences • Puts best self forward 20.5 Empathy (is aware of others) • Sees other perspectives • Values the feelings of others • Appreciates diversity