Model Methods Course Outline

Elementary Science (K-5)

Acknowledgements

The Believe and Prepare Science Collaborative was designed to bring together the best minds from both teacher preparation and K-12 to design a teaching methods course outline for elementary science courses that, in turn, is available for public use. This collaborative was led by BSCS Science Learning. The goal of the collaborative was to ensure that teachers completing teacher preparation programs have a deep understanding of the phenomenon-based, three-dimensional instructional model required to effectively implement standards-aligned high-quality science curricula.

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GOALS

- Support coherent and engaging learning experiences for teacher candidates
- Prepare teacher candidates to be effective science teachers
- Develop guidance to ensure teacher candidates completing preparation programs are well prepared

INTRODUCTION AND PURPOSE

This Model Methods Course Outline, the product of a collaboration among Louisiana higher education and K–12 science faculty, led by experts at the Biological Sciences Curriculum Study (BSCS) Science Learning located in Colorado Springs, Colorado, outlines student learning outcomes, course design principles, and suggested activities and assessments for a course or sequence of courses that address instructional methods for prospective elementary (K-5) science teachers.

This document is intended to provide teacher preparation programs with appropriate guidance to ensure that teacher candidates completing their programs are well prepared to effectively engage elementary students in standards-aligned, culturally relevant, and equitable science learning and gain experience in assessing and utilizing high-quality curriculum materials. It includes elementary science education teacher competencies aligned to professional standards for teacher preparation. Course design principles, sample activities and sample teacher candidate assessments are provided to be used and/or adapted to the particular education preparation provider program using this guide.

Instructional Shifts (LA Shifts in Science)

- Construct and apply content knowledge
  - Content knowledge is critical and evident in the standards in the Disciplinary Core Ideas, the key ideas that have broad importance within and across multiple science or engineering disciplines. However, simply constructing content knowledge is not enough. Students must investigate and apply content knowledge to scientific phenomena.
- Investigate, evaluate and reason scientifically
  - Scientists do more than learn about science; they “do” science. Science instruction must integrate the practices, or behaviors, of scientists as they investigate real-world phenomena. Similarly, engineers design solutions to problems.
- Connect ideas across disciplines
  - For students to develop a coherent and scientifically-based view of the world, they must make connections across the domains of science (life science, physical science, earth and space science, environmental science, and engineering, technology, and applications of science). The crosscutting concepts have applications across all domains.

Note: These statements were taken directly from Louisiana Student Standards Science, Shifts in Science.

Louisiana Priorities

- Motivate and support student learning by facilitating lessons that use a variety of phenomena that is relevant to students' knowledge, community and experiences to understand content.
- Apply research-based strategies to provide students an equitable, culturally relevant classroom environment and support a growth mindset.

TEACHER CANDIDATE LEARNING OUTCOMES AND DESIGN PRINCIPLES

(for teaching and teacher preparation in general and for science)

Teacher candidate experiences should be grounded in elementary science content, pedagogy, and assessment to provide ample opportunities to demonstrate proficiency so where possible sample assessments and activities are aligned to the Learning Outcomes.

Design Principles	**Learning Outcomes**	**Standards Alignment**	
	1. Planning for Science Instruction	[CAEP]	[NSTA/ASTE (science)]
I. Scientific Knowledge Construction and Application This course presents teacher candidates with ideas of how to use methods within the nature of science to explore real-world phenomena, support sense-making of grade appropriate science content and processes, and of application of science or design challenges. **II. Nature of Science** This course will explore the tenants of the nature of science, so that teacher candidates understand what science is	1a. Describe the nature of science, including scientific content knowledge, inquiry, data collection, processing skills and ways of knowing.	R1.2 Content	Standard 1: Content Knowledge
	1b. Describe the components of three-dimensional standards.	R1.2 Content	Standard 1: Content Knowledge
	1c. Evaluate and implement 3D science teaching, including: unpacking content standards, instructional materials, units of study, lesson plans, and learning experiences.	R1.1 The Learner and Learning R1.2 Content R1.3 Instructional	Standard 1: Content Knowledge Standard 2: Content Pedagogy

and what science isn't. **III. Science is an Iterative Process:** This course provides teacher candidates the opportunity to explore science as a dynamic practice of asking scientific questions, making observations, analyzing data, and formulating conclusions. **IV. Engaging with Engineering and Science:** This course provides teacher candidates with an introduction to engineering as an important discipline and how it both intertwines with traditional scientific processes and requires specialized methods of learning and application.		Practice	
	1d. Use different types of questions to determine whether their students are engaged in science related activities, applying science content in engineering activities and/or for assessment.	R1.1 The Learner and Learning R1.3 Instructional Practice	Standard 2: Content Pedagogy
	1e. Analyze high-quality instructional materials for the presence of scientific principles. For example, but not limited to, NGSS elements using the EQuIP Rubric (Guidelines provided by the NSTA website).	R1.2 Content	Standard 2: Content Pedagogy
	1f. Understand how science content builds in complexity within and across grades to inform lesson and unit planning.	R1.2 Content	Standard 1: Content Knowledge
	1g. Scaffold levels of inquiry (zone of proximal development) for students based on developmental needs to assess and support prior knowledge and concept development.	R1.3 Instructional Practice	Standard 2: Content Pedagogy
Design Principles	**2. Culture and Environment**	CAEP	NSTA/ASTE (science)
V. Engaging with Engineering and Science: This course provides teacher candidates with an introduction to engineering as an important discipline and how it both intertwines with traditional scientific processes and requires specialized methods of learning and application.	2a. Create and maintain classroom culture that encourages scientific discourse by developing structures to foster student sensemaking. (e.g. setting classroom norms, consensus building)	R1.1 The Learner and Learning	Standard 3: Learning Environments
	2b. Promote student-to-student discourse that demonstrates shared ownership and respect for the ideas shared of others.	R1.3 Instructional Practice	Standard 3: Learning Environments
	2c. Develop and promote a positive and safe classroom learning culture for a variety of populations based on an understanding of individual differences.	R1.1 The Learner and Learning	Standard 3: Learning Environments

VI. Culture and Environment: This course provides teacher candidates the opportunity to develop and practice behaviors and mindsets that support classroom environments where productive science learning and understanding takes place for all participants.	2d. Motivate and support student learning by facilitating lessons that use a variety of phenomena that are relevant to students' knowledge, community and experiences. to understand content.	R1.2 Content	Standard 2: Content Pedagogy
	2e. Apply research-based strategies that provide students an equitable, culturally relevant classroom environment and support a growth mindset.	R1.1 The Learner and Learning	Standard 3: Learning Environments
Design Principles	**3. Procedures, Assessment, Reflection**	CAEP	NSTA/ASTE (science)
VII. Active and Experiential Learning This course provides regular opportunities for teacher candidates to actively engage in, unpack, and reflect on a variety of science and engineering instructional strategies and teaching experiences. **VIII. Reflective Practice:** This course requires that teacher candidates develop the ability to set student learning goals and their own professional learning goals—and to reflect on those goals frequently.	3a. Implement developmentally-appropriate lab safety and classroom management strategies specific to the science classroom.	R1.3 Instructional Practices	Standard 3: Learning Environments
	3b. Identify the three dimensions of the science standards within high-quality assessment items.	R1.2 Content	Standard 2: Content Pedagogy
	3c. Evaluate the standard, objective, and lesson alignment of three dimensional assessment item sets in multiple formats.	R1.2 Content	Standard 2: Content Pedagogy
	3d. Engage in critical reflection on their own science teaching using student data from formative and summative assessments to continually improve their instructional effectiveness.	R1.3 Instructional Practices	Standard 2: Content Pedagogy
	3e. Engage in professional learning, act ethically, take responsibility for student learning, and collaborate with others to work effectively with diverse students.	R1.4	Standard

COURSE(S) DESIGN PRINCIPLES

- Ideas and practices intended to support meaningful, engaging, relevant, and coherent science educational experiences for teacher candidates
- Prepare them to be effective science teachers and members of school-based learning communities.

Design Principle	Instructor will…	Teacher Candidate will…
Scientific Knowledge Construction and Application This course presents teacher candidates with ideas of how to use methods within the nature of science to explore real-world phenomena, support sense-making of grade appropriate science ideas and processes and of application of science or design challenges.	● Provide a variety of real-world phenomena for candidates. ● Use accurate scientific vocabulary. ● Facilitate the process of selecting phenomena that can be explored and understood using science knowledge and practices. ● Model student sensemaking discussions. ● Ensure teacher candidates are aware and have knowledge of the science content as indicated within the state science standards. ● Respond to teacher candidate partial or intuitive ideas with meaningful, nature-of-science feedback.	● Utilize real-world phenomena for its application for learners to investigate and integrate sense-making with scientific content knowledge. ● Utilize scientific content knowledge to be applied in a variety of productive manners. ● Plan student sensemaking discussions. ● Identify learning progressions of the three dimensions of science standards across grade bands (K-2, 3-5). ● Map out science content to be covered within a grade and show the concepts connected across science ideas.
Nature of Science This course will explore the tenants of the nature of science so that teacher candidates understand what science is and what science isn't.	● Introduce the tenants of the nature of science. ● Showcase how the tenants of the nature of science can be understood through active science lessons.	● Incorporate the tenants of the nature of science into their teaching of science.
Science is an Iterative Process: This course provides teacher candidates the opportunity to explore science as a dynamic practice of asking scientific questions, making observations, analyzing data, and formulating conclusions.	● Model and facilitate activities that actively engage candidates in the iterative process of science where they continuously question, gather data, and construct knowledge within science lessons.	● Generate scientific learning experiences where student learners question, investigate, construct, and apply content knowledge to build a deeper understanding of the natural world. ● Facilitate scientific learning experiences where the formation of scientific knowledge leads to additional questioning and the iterative process of science.

<table>
<tr><th>Design Principle</th><th>Instructor will…</th><th>Teacher Candidate will…</th></tr>
<tr><td>Engaging with Engineering and Science:

This course provides teacher candidates with an introduction to engineering as an important discipline and how it both intertwines with traditional scientific processes and requires specialized methods of learning and application.</td><td>Introduce engineering as a learning discipline to candidates and explore the nuances that separate it from science.
Present specific examples of real-world phenomena and applications of relevant Science and Engineering Practices
Create experiential activities that allow teacher candidates to see effective science and engineering learning in the classroom.
Create a learning environment that fosters risk-taking, embraces failure, and other important science and engineering soft skills.</td><td>Be able engage their learners in creating knowledge through scientific practices and apply knowledge through engineering practices.
Be able to connect science and engineering practices to science content knowledge and engineering solutions, respectively.
Utilize engineering design to apply scientific content knowledge in real-world scenarios.
Expand on student’s innate curiosity and problem-solving skills to provide them with structured opportunities to create design solutions.</td></tr>
<tr><td>Culture and Environment:

This course provides teacher candidates the opportunity to develop and practice behaviors and mindsets that support classroom environments where productive science learning and understanding takes place for all participants.</td><td>Facilitate activities and tasks with accessible entry points that present meaningful opportunities for teacher candidates to explore different methods of developing an environment that supports a successful and growth mindset.
Model the thinking that goes into creating a classroom culture that encourages scientific discourse by developing structures to foster student sensemaking.
Motivate and support student learning by teaching lessons using phenomena that are relevant and relatable.</td><td>Employ classroom culture strategies that produce scientific learning experiences for all learners that align with successful mindset practices.
Actively participate in supporting classroom culture by contributing to norm creation and engaging in scientific discourse during sensemaking discussions.</td></tr>
<tr><td>Active and Experiential Learning

This course provides regular opportunities for teacher candidates to actively engage in, unpack, and</td><td>Provide activities and tasks with accessible entry points that present meaningful opportunities for teacher candidates to</td><td>Be active and engaged participants in scientific processing skills, in working on tasks with classmates, and in making decisions</td></tr>
</table>

Design Principle	Instructor will…	Teacher Candidate will…
reflect on a variety of science and engineering instructional strategies and teaching experiences.	explore and co-create scientific and pedagogical understanding. • Create a safe, candidate-driven classroom environment in which candidates are encouraged to take risks or make mistakes, and in which they are able to make decisions about the direction for instruction through the results of their exploration of content and strategies. • Facilitate teacher candidates' active learning through a variety of instructional strategies, including inquiry, problem solving, critical thinking, and reflection, with limited time spent in "direct teach" activities aligned to three dimensions of the standards. • Model questioning techniques for scientific discourse. • Facilitate role-playing scenarios for developing empathy for productive struggle. • Provide regular opportunities for meaningful debriefing and reflection connected to practice and research. • Facilitate role-playing of collaborative planning and student work analysis activities. • Provide opportunities for the teacher candidates to participate and implement science teaching.	about creating effective scientific learning experiences. • Collaborate, contribute, and support the peer learning experience. • Self-advocate and self-assess/reflect on one's own learning by discussing course assignments and concepts with the instructor and/or classmates outside of class. • Practice empathy by role-playing the student in productive struggle for problem solving. • Practice role-playing the teacher guiding productive struggle. • Unpack and debrief teaching and learning experiences regularly to reflect on research and applications for teaching students. • Model lesson debrief with students. • Engage in role-playing collaborative planning and student work analysis activities.
Reflective Practice:	• Provide opportunities for teacher candidates to develop their own	• Develop professional learning goals and

Design Principle	Instructor will…	Teacher Candidate will…
This course requires that teacher candidates develop the ability to set student learning goals and their own professional learning goals—and to reflect on those goals frequently.	professional learning goals. ● Expose teacher candidates to national and state professional organizations and conferences for science teachers (i.e., NSTA: National Science Teaching Association,LSTA: Louisiana Science Teachers Association, etc.). ● Provide frequent, timely feedback to teacher candidates. ● Model lessons and reflect with teacher candidates using their constructive feedback to demonstrate how learning goals can be refined. ● Model assessment data collection and analysis. ● Guide candidates to consider reasons for equity gaps that may exist across groups of students, including possible bias in curriculum or in teacher mindsets, and reflect on strategies to address those gaps. ● Provide opportunities for teacher candidates to learn about the local community and its cultures.	reflect on those goals frequently. ● Consider constructive feedback from other teacher candidates and peers in the field, such as a faculty member or a mentor teacher, and refine/revise professional learning goals as needed. ● Learn about national and state professional organizations and conferences for science teachers (i.e., LSTA, Louisiana Science Teacher Association, NSTA: National Science Teaching Association). ● Develop learning outcomes for diverse students and assess student progress against outcomes regularly. ● Analyze and reflect on assessment data. ● Develop next steps for instruction based on student data. ● Consider reasons for equity gaps in student progress—including possible biases or mindsets about particular students or groups of students—and reflect on strategies to address those gaps. ● Learn about the local community and its cultures, and reflect on how that should inform your instruction.

SAMPLE ACTIVITIES

Teacher candidate sample activities experiences align with elementary science content, pedagogy, standards, and assessments to provide ample opportunities to demonstrate proficiency. Each sample activity is named, briefly described, and includes a link to the activity, alignment to outcomes/design principles, and notes.

Activity	Brief Description	Link	Alignment to Learning Outcomes/ Design Principles	Notes: Important Information
Non-confirmatory Interactive Demonstrations: A Science Teaching Strategy	Candidates learn how to present an interactive science demonstration.	Science Demonstration Lesson Template	#1a, 1d, 1f, 1g, 2d, 3d	Pre-service teachers create interactive science demonstrations, practice teaching them in front of peers, and teach them live in a field experience.
Helping Students Connect to Science through Louisiana-specific Phenomena	Phenomena Analysis - Consider a gallery walk of curated phenomena to analyze against criteria and/or have candidates develop phenomena for analysis.	LDOE Teacher Leader Summit 2022 - Louisiana - Specific Phenomena	#1a, 1b, 2d, 2e	Phenomena, sense-making, equity, question development, and next-steps.
Three-Dimensional Science Standards	3-Dimensional Science Standards presentation, small group and whole class gallery walk to learn about each dimension, analogy creation for a performance standard containing all 3 dimensions, and a final writing assessment to determine learning.	3-Dimensional Standards	#1b, 1c, 3c	See the directions document and then access the materials within each folder.
LDOE Learning Module:	In this module, candidates will	Science Learning Modules	#2a,2b	Access documents provided at the

Activity	Brief Description	Link	Alignment to Learning Outcomes/ Design Principles	Notes: Important Information
Productive Science Talk and Planning for Discussion	reflect on key aspects of productive science discussions, explore three discussion types by analyzing classroom videos, and utilize a planning tool for facilitating science discussions.			link.
OpenSciEd: Establishing Norms and Classroom Culture	Highlights the supports built into OpenSciEd that enables the development of a positive classroom culture	OpenSciEd: Establishing Norms and Classroom Culture	#2c, 2e	This should be replaced with the elementary presentation once it is published. Series of webinars.
Making Science Instruction Compelling for All Students: Using Cultural Formative Assessment to Build on Learner Interest and Experience	Module includes all resources that PD facilitators might need to adapt and run the sessions.	Making Science Instruction Compelling for All Students: Using Cultural Formative Assessment to Build on Learner Interest and Experience	#2d, 2e	Includes slides, speaker's notes, facilitator guide, embedded resources and sample student work.
NGSS Model Activity: Changing Force	Candidates participate in the lab activity and identify elements of the NGSS withinit.	Changing Force	#3b	Need to provide candidates with copies of DCI, CCC, and SEP matrices.
NGSS IslandWood: Community Waters (4th grade)	Community Waters is a stormwater engineering unit that incorporates physical science standards and the	Grade 4: Island Wood: Community Waters	#1a, 1d, 2e, 3a	Includes extensive teacher manual for 15 lessons.

Activity	Brief Description	Link	Alignment to Learning Outcomes/ Design Principles	Notes: Important Information
	Ambitious Science Teaching framework. Students explore the phenomenon of why flooding happens in Seattle.			

Sample Assessments

These performance-based assessments are intended to be authentic summative measures of candidates' understanding of the knowledge and skills described in the Candidate Learning Outcomes and Design Principles, using field experience, when possible, as an opportunity for candidates to demonstrate their learning while applying their skills in the classroom.

Each assessment addresses multiple Student Learning Outcomes and has four interconnected parts— **Analyze, Develop, Implement, and Evaluate**—that are intended to be implemented together rather than over an extended period of time.

Planning for Science Instruction

Science is a dynamic practice of asking scientific questions, gathering data, evaluating evidence and generating new insights. The candidate must possess a deep understanding of the foundational pieces of science instruction, scientific content knowledge and the three-dimensional science standards (e.g., the Louisiana Student Standards for Science (LSSS), Next Generation Science Standards (NGSS). These understandings must be connected to the planning and implementation of high-quality instructional materials.

When educators understand these critical components, they are able to make connections explicit in their lesson design and delivery, and they are able to scaffold knowledge for students within and across lessons and grade levels, resulting in increased student achievement in science.

This performance-based assessment is separated into four parts: Analyze, Develop, Implement, and Evaluate.

Part 1: Analyze

- The new Louisiana State Science Standards (LSSS): Why do we describe the new LSSS as 3-Dimensional standards?
    - Explain what the 3-Dimensions of the Louisiana state standards are and how each dimension adds to the learning experience in the elementary classroom.

- What is a performance expectation and how does the performance expectation build on the 3-Dimensions?

- 3-Dimensional Standards within High-Quality Science Curriculum
    - Select a lesson from a high-quality science curriculum and annotate the lesson's objective(s) to identify the 3-dimensions.
    - Annotate within the lesson where each dimension of the standard is included in the lesson.

Part 2: Develop

- Create a concept map of LSSS performance expectation(s) that aligns with the lesson chosen and annotate the lesson highlighting how each dimension is addressed.

Part 3: Implement

- Select one aspect of the lesson that focuses on one of the three dimensions to teach as a mini-lesson.
- Submit a 5-10 minute video demonstrating how you addressed the chosen dimension in the lesson as a reflection of the instructional practices identified within the concept map.

Part 4: Evaluate

- Evaluate the learning cycle process as you plan for instruction of a high-quality lesson by identifying the three dimensions of the Louisiana State Science Standards, annotating the lesson to prepare for implementation, and implementation of one part of the lesson that highlights one of the three dimensions. Submit a 500-600 word narrative addressing each aspect of the cycle.

Draft Rubric for Planning for Science Instruction

Assessment 1	Demonstrated	Progressing	Not Met
Part 1: Analyze	• The response provides a clear and accurate explanation of the three dimensions of the LSSS(SEP, CCC, and DCI) and effectively describes how each dimension enhances the learning experience in the elementary classroom. • The response provides a clear and accurate explanation of what a performance expectation is in the context of the LSSSand effectively	• The response provides an explanation of the three dimensions of the Louisiana State Science Standard (SEP, CCC, and DCI) but many lack clarity or accuracy in describing how each dimension adds to the learning experience in the elementary classroom. • The response provides an explanation of what a performance expectation is but may lack clarity	• The response does not provide an explanation of the three dimensions of the Louisiana State Science Standard (SEP, CCC, and DCI) or fails to describe how each dimension enhances the learning experience in the elementary classroom. • The response does not provide an explanation of what a performance expectation is or fails to explain how it builds on the three

Assessment 1	Demonstrated	Progressing	Not Met
	explains how a performance expectation builds on the three dimensions (SEP, CCC, and DCI). ● The response effectively identifies the three dimensions (SEP, CCC, and DCI) within a lesson's objectives AND within the lesson from a high-quality science curriculum and provides clear and accurate annotations explaining how each dimension is included.	or accuracy in explaining how a performance expectation builds on the three dimensions (SEP, CCC, and DCI) of the Louisiana State Science Standards. ● The response effectively identifies the three dimensions (SEP, CCC, and DCI) within a lesson's objectives AND within the lesson from a high-quality science curriculum, but the annotations may lack clarity or accuracy in explaining how each dimension is included.	dimensions (SEP, CCC, and DCI) of the Louisiana State Science Standards. ● The response does not effectively identify the three dimensions (SEP, CCC, and DCI) within a lesson's objectives AND within the lesson from a high-quality science curriculum or fails to provide annotations explaining how each dimension is included.
Part 2: Develop	● The concept map demonstrates a clear and comprehensive alignment between the chosen lesson and the relevant LSSS performance expectation(s). ● Each dimension is accurately identified and annotated in the lesson, highlighting how it is addressed. ● The concept map provides a clear visual representation of the connections and relationships between the lesson and the three dimensions.	● The concept map shows alignment between the chosen lesson and the LSSS performance expectation(s), but some connections or annotations may lack clarity or accuracy. ● Some dimensions may be partially identified or the annotations may not effectively highlight how each dimension is addressed. ● The concept map may lack clarity in representing the connections and relationships between the lesson and the dimensions.	● The concept map does not effectively demonstrate alignment between the chosen lesson and the LSSS performance expectation(s). ● Connections and annotations are unclear, inaccurate, or missing. The dimensions may not be identified or their connection to the lesson is not effectively highlighted. ● The concept map does not clearly represent the connections and relationships between the lesson and the dimensions.

Assessment 1	Demonstrated	Progressing	Not Met
Part 3: Implement	• The video demonstrates a clear and effective implementation of the chosen dimension in the lesson. • The chosen aspect of the lesson is taught as a mini-lesson, reflecting the instructional practices identified within the concept map. • The video effectively showcases how the chosen dimension is addressed, including relevant instructional strategies, student engagement, and assessment techniques.	• The video demonstrates an implementation of the chosen dimension, but some elements may lack clarity or effectiveness. • The chosen aspect of the lesson is partially taught as a mini-lesson, and the reflection of instructional practices identified within the concept map may be limited. • The video may lack clarity in showcasing how the chosen dimension is addressed and may not effectively demonstrate instructional strategies, student engagement, and assessment techniques.	• The video does not effectively demonstrate the implementation of the chosen dimension in the lesson. • The chosen aspect of the lesson is not adequately taught as a mini-lesson, and the reflection of instructional practices identified within the concept map is missing or insufficient. • The video does not showcase how the chosen dimension is addressed, and instructional strategies, student engagement, and assessment techniques are absent or unclear.
Part 4: Evaluate	• The narrative provides a thorough and reflective evaluation of the learning cycle process. • The student identifies and accurately describes the three dimensions of the Louisiana State Science Standards. • The lesson is appropriately annotated to prepare for implementation, and the implementation of one part of the lesson effectively highlights one of the three dimensions.	• The narrative provides an evaluation of the learning cycle process, but some elements may lack depth or clarity. • The identification and description of the three dimensions may be partially accurate or unclear. • The annotation of the lesson may be incomplete or lack effectiveness in preparing for implementation. • The implementation of one part of the lesson may partially highlight	• The evaluation of the learning cycle process is incomplete or lacks depth. • The identification and description of the three dimensions are missing or inaccurate. • The annotation of the lesson is missing or ineffective in preparing for implementation. • The implementation of one part of the lesson does not effectively highlight one of the three dimensions.

Assessment 1	Demonstrated	Progressing	Not Met
	• The narrative demonstrates insightful reflection and addresses each aspect of the learning cycle process.	one of the three dimensions. • The reflection may lack depth or coherence in addressing each aspect of the learning cycle process.	• The reflection is missing or insufficient in addressing each aspect of the learning cycle process.

Additional sample activities to be used for assessing candidates for Planning for Science Instruction learning outcomes can include: Inquiry Investigation - Bottle Rocket Cars and Newton's Laws of Motion, Problems-Based Learning Assignment, Learning Cycle (planning of lesson, implementation of lesson in grades 1-5 classroom, and reflection - self and collaborative with faculty advisor), Classroom field experience, Development and/or annotation of UbD unit plan or annotation of high-quality unit.

Culture and Environment

Effective candidates are able to develop and cultivate classroom practices that provide students opportunities to make authentic personal connections to scientific phenomena and encourage behaviors that support equitable scientific discourse. When educators use a high-quality science curriculum, the students are engaged in relevant and meaningful scenarios that reflect the practice of science and engineering as experienced in the real world, thus encouraging the use of structures which foster student sensemaking and encourage growth mindset.

This performance-based assessment is separated into four parts: Analyze, Develop, Implement, and Evaluate.

Part 1: Analyze

- Analyze a selected unit plan from a high-quality instructional material in order to develop structures for students to engage in productive classroom discussions of scientific content. Select a point in the unit where students engage in a sensemaking discussion of an important concept that is key to understanding a phenomenon that is engaging and relevant to students.
- Submit a classroom culture guide where the the following is included:
  - Identify basic norms for classroom discussion
  - List key methods you would want to use in order for students to share their learning in a way that allows them to have collaborative ownership of their learning.
  - Identify different populations of students that could be in your classroom and ways that their experiences and knowledge can be shared with their peers in a positive manner.
  - Write questions that you could ask students in order to assist them in sharing their learning in a manner that develops a growth mindset.

Part 2: Develop

- Develop a plan for implementing your discussion strategies by identifying:
    - Key behaviors you want students to engage in during the discussion
    - How you want to model these behaviors in students
    - How you will keep track of these behaviors and how to reteach when students do not follow them
    - Ways that you can facilitate and encourage a variety of viewpoints from students during the discussion
    - How you plan on fostering a growth mindset to build resilience in learning for students
    - Methods for celebrating collaboration and shared learning
- Submit a discussion planning template and monitoring document that reflects your plan for facilitating the discussion.

Part 3: Implement

- Implement the plan and facilitate a scientific sensemaking discussion utilizing the classroom culture plan and discussion planning template and monitoring documents.
- Submit a 5-10 minute video demonstrating how you created the framework for a successful classroom culture and implemented your strategies to successfully facilitate a productive sensemaking discussion.

Part 4: Evaluate

- Evaluate your attempt to create a successful classroom culture to facilitate productive science learning. Submit a 500-600 word narrative addressing the following points:
    - How effective was your classroom culture plan at creating a framework for productive scientific discussions? Cite evidence from your video and include examples of students demonstrating positive scientific discussion.
    - What adjustments–if any–did you need to make to your plan to reach your goal of creating a successful classroom culture? Why?
    - Which parts of your classroom culture plan were the most challenging to implement and why? Explain how you will work to improve in this area.

Draft Rubric for Culture and Environment

Assessment 2	Demonstrated	Progressing	Not Met
Part 1: Analyze	• The student demonstrates a comprehensive analysis of a selected unit plan, identifying a suitable point for a sensemaking discussion. • The classroom culture guide includes clear and well-identified norms, methods for collaborative learning, strategies for sharing experiences, and growth mindset questions.	• The student conducts an analysis of a selected unit plan, but some elements lack depth or clarity. • The classroom culture guide includes basic norms, some methods for collaborative learning, and strategies for sharing experiences, but may lack detail or effectiveness. • Growth mindset questions may be partially developed.	• The analysis of the selected unit plan is incomplete or lacks understanding. • The classroom culture guide lacks clear norms, methods for collaborative learning, strategies for sharing experiences, and growth mindset questions are missing or irrelevant.
Part 2: Develop	• The student develops a detailed plan for implementing discussion strategies, including key behaviors, modeling strategies, monitoring and reteaching methods, facilitating diverse viewpoints, fostering growth mindset, and celebrating collaboration. • The discussion planning template and monitoring document demonstrate a comprehensive plan for facilitating the discussion.	• The student develops a plan for implementing discussion strategies, but some elements lack detail or clarity. • Key behaviors, modeling strategies, monitoring and reteaching methods, facilitating diverse viewpoints, fostering growth mindset, or celebrating collaboration may be partially developed. • The discussion planning template and monitoring document may lack some components of a comprehensive plan.	• The development of the plan for implementing discussion strategies is incomplete or lacks detail. • Key behaviors, modeling strategies, monitoring and reteaching methods, facilitating diverse viewpoints, fostering growth mindset, or celebrating collaboration are missing or insufficiently developed. • The discussion planning template and monitoring document are incomplete or lack key components.

Assessment 2	Demonstrated	Progressing	Not Met
Part 3: Implement	● The student successfully implements the classroom culture plan and discussion strategies, demonstrating effective facilitation of a scientific sensemaking discussion. ● The 5-10 minute video showcases the framework for productive scientific discussions, student engagement, and positive scientific discourse.	● The student implements the classroom culture plan and discussion strategies, but some elements may lack effectiveness or may not be fully demonstrated in the video. ● The video may not fully showcase the framework for productive scientific discussions, student engagement, or positive scientific discourse.	● The implementation of the classroom culture plan and discussion strategies is incomplete or lacks effectiveness. ● The video does not adequately showcase the framework for productive scientific discussions, student engagement, or positive scientific discourse.
Part 4: Evaluate	● The student provides a thorough and reflective evaluation of the effectiveness of the classroom culture plan in facilitating productive scientific discussions, supported by evidence from the video and examples of positive scientific discourse. Adjustments made to the plan are clearly explained, demonstrating insight into the process. Challenges in implementation are identified, along with a plan for improvement.	● The student provides an evaluation of the effectiveness of the classroom culture plan, but some elements lack depth or clarity. The evidence from the video and examples of positive scientific discourse may be limited. Adjustments made to the plan may not be fully explained, and the plan for improvement may be vague or lacking.	● The evaluation of the effectiveness of the classroom culture plan is incomplete or lacks depth. The evidence from the video and examples of positive scientific discourse are missing or insufficient. Adjustments made to the plan are not explained, and the plan for improvement is missing or lacks coherence.

Additional sample activities to be used for assessing candidates for Culture and Environment learning outcomes can include: Learning Cycle (planning of lesson, implementation of lesson in grades 1-5 classroom, and reflection - self and collaborative with faculty advisor), classroom field experience, evelopment and/or annotation of UbD unit plan or annotation of high-quality unit.

Procedures, Assessment, Reflection

As the standards for science have shifted to include three-dimensional elements, the evidence of this learning must showcase students using practices with core ideas and crosscutting concepts to make sense of phenomena and/or design solutions. Effective candidates understand that the alignment of the standard to the assessment is critical when determining the quality of three- dimensional assessments. Candidates strive to continuously improve their knowledge of both science content and their pedagogy by engaging in practices such as analyzing learning gains for individual students, the class as a whole, and subgroups of students to inform planning and teaching.

This performance-based assessment is separated into four parts: Analyze, Develop, Implement, and Evaluate.

Part 1: Analyze

Science Autobiography - Initial Reflection

Writing Assignment; You will construct a science autobiography describing your personal experiences with science, in or out of school. We all bring preconceived ideas and beliefs to learning to teach science -- "teachers teach as they were taught." The first step in becoming an enthusiastic and skilled teacher of science is to reflect upon the experiences which have shaped your current ideas about science. In this reflection, you will examine your own science education history and your attitudes toward science. The goal is that you will use your personal reflections to help you become a better science teacher.

Write your science autobiography. There is no particular format for this writing exercise. You might want to recall your impressions of science as a young child. You might want to describe activities or classroom events that caused you to think about science in a particular way. Perhaps you have a “horror story” about a science experience that you have never been able to shake. Or, perhaps you engaged in a hands-on science experiment that really stimulated your thinking and creativity. Whatever the case, please write about the equivalent of two pages (double-spaced) on your experiences with science and how those experiences have contributed to your present understanding of science and science teaching and learning.

Before you begin writing… Think back to your most vivid memories of being a science student, up to and including your college experiences. Jot a few of these ideas down as you begin to reflect on your view of science and science learning.

Questions to address in the essay (does not have to be in this order, and please be honest and open):

- When you look back at your science education, what do you see?
- How much science did you study in school? (Elementary up through college)
- Did you like science? Hate it? Did you ever even think about it?
- What personal experiences with school science, scientists, science in the media, and science teachers stand out to you?

- Identify the different kinds of activities, assessments, and/or teacher characteristics that were effective and ineffective for you as a student. Why were they effective or ineffective?

Part 2: Develop

- Select one instructional activity or assessment that you feel promotes student learning and/or demonstrates student understanding of the standards that you would like to better understand in relation to informing your instructional practice.
- Develop AND submit a plan for implementing your chosen instructional activity or assessment by identifying:
    - Key aspects of the activity or assessment as they relate to student engagement and learning
    - Alignment of the activity or assessment to a science standard of choice
    - Ways you could incorporate the learning activity into a lesson OR implement the assessment as a measure of student learning
    - Methods for determining if the activity or assessment was effective in either fostering or measuring student learning of your chosen science standard.

Part 3: Implement

- Submit a 5-10 minute video demonstrating how you implemented your chosen activity to promote student learning across the three dimensions OR submit your analysis of the effectiveness of your chosen assessment using student data.

Part 4: Evaluate

Science Autobiography - Final Reflection

In this final reflection, you will look back on how your perspective of learning and teaching science in the early childhood classroom has evolved as a result of your experiences in the course. This includes experiences in the methods classroom, in your field placement, and through the readings and activities you completed.

At the end of the semester, you will write an approximately 500-word analysis assessing your teaching (what worked, what didn't, and how to improve). In particular, discuss where you started in science teaching, where you are now, and where you hope to go. Areas addressed in the paper might include your general goals for your students, questioning, learning cycle, wait time, instructional strategies, forms of assessment, 3 dimensions of the science standards, students with exceptionalities, struggling students, and culturally sensitive teaching.

Draft Rubric for Procedures, Assessment, Reflection

Assessment 3	Demonstrated	Progressing	Not Met
Part 1: Analyze	• Reflection of Science Education - Gave insight and specific examples regarding science education experiences. • Personal Experiences - Shares personal experiences and how they impacted student thoughts on science. • Activity Experiences - Explains why science activities were effective or ineffective for self.	• Reflection of Science Education - Gave only one or two science education experiences. • Personal Experiences - Lists personal experiences in science. • Activity Experiences - States effective and ineffective activities.	• Fails to adequately address or does not include 1 or more of the following aspects: reflection of science education, personal experiences, and effective/ineffective science activities.
Part 2: Develop	• The plan provides a clear and thorough explanation of an instructional activity or assessment that promotes student learning and/or demonstrates student understanding of the standards. The plan for implementing the activity or assessment includes key aspects related to student engagement and learning, alignment to a science standard, incorporation into a lesson, and methods for determining effectiveness.	• The plan identifies an instructional activity or assessment that promotes student learning and/or demonstrates student understanding of the standards, but the plan for implementing the activity or assessment may lack clarity or thoroughness in addressing key aspects related to student engagement and learning, alignment, incorporation, and methods for determining effectiveness.	• The plan does not effectively identify or explain an instructional activity or assessment that promotes student learning and/or demonstrates student understanding of the standards, OR the plan for implementing the activity or assessment lacks key aspects related to student engagement and learning, alignment, incorporation, and methods for determining effectiveness.
Part 3: Implement	• The submitted video effectively demonstrates the implementation of the chosen activity, showcasing student engagement and learning across the three dimensions (SEP, CCC, and DCI). The video or analysis	• The submitted video effectively demonstrates the implementation of the chosen activity but may lack clarity or thoroughness in showcasing student engagement and learning across the three	• The submitted video does not effectively demonstrate the implementation of the chosen activity or analysis of the assessment's validity does not provide clear evidence of

Assessment 3	Demonstrated	Progressing	Not Met
	provides clear evidence of student learning and effectively analyzes the validity of the assessment using student data.	dimensions. The video or analysis provides some evidence of student learning and attempts to analyze the validity of the assessment using student data.	student learning or lacks thoroughness in using student data.
Part 4: Evaluate	• Reflection of Science Education - Gave insight and specific examples regarding science education experiences. • Personal Experiences - Shares personal experiences over the past semester and how those experiences impacted beliefs regarding science and science instruction. • Activity Experiences - Explains why science activities and/or experiences this semester were effective or ineffective for self.	• Reflection of Science Education - Gave only one or two science education experiences. • Personal Experiences - Lists personal experiences over the past semester. • Activity Experiences - States effective and ineffective activities from the course.	• Fails to adequately address or does not include 1 or more of the following aspects: reflection of science education experiences, personal experiences, and science activity experiences.

Additional sample activities to be used for assessing candidates for Procedures, Assessment, and Reflection learning outcomes can include: Problems-Based Learning Assignment, Science Circus, Learning Cycle (planning of lesson, implementation of lesson in grades 1-5 classroom, and reflection - self and collaborative with faculty advisor), Classroom field experience, Development and/or annotation of UbD unit plan or annotation of high-quality unit.

CONSIDERATIONS FOR USE

In implementing this document in a teacher preparation program, there are several aspects to consider:

- **Program scaffolding**- Teacher candidates who take a science course early in their program have a different understanding compared to those who have more experience with implementing theory into practice. In using this guide, the instructor should think about the teacher candidate readiness for each outcome in relation to the sequence of courses in the educator preparation provider’s particular program.

- **Opportunities for clinical practice**- Ideally teacher candidates need to work with children in grades 1-5 over multiple days of teaching; however, this is not always possible. Options for practice teaching might include placement in local schools, peer teaching, virtual opportunities, weekend/after school/evening programs, etc.
- **Emphasis on Foundational Concepts**- When developing foundational instructional skills with preservice teachers, it is beneficial to consider that terms or resources may be specific to a curriculum or school system. Educational technology and access to materials to teach science can vary from school-to-school and year-to-year. Emphasize the concepts that can be applicable across systems to prepare preservice teachers for all potential contexts. Teach for transferable skills such as understanding the format of the curriculum, being able to make adjustments for a specific group of students, ensuring that whatever curriculum is being used meets best practice benchmarks for scientific engagement and discussion, etc.