Appendix A

Traditional Lesson Planning

The following assignment instructions were provided to participants as part of the course.

You'll start by selecting math and science standards for a chosen grade level (grades 3-5 for PCE or grades 6-8 for MCE/AYA). You'll look for natural connections between the standards, such as using measurement skills to interpret scientific data or applying geometric concepts to understand natural phenomena.

Once you've selected your standards, you'll develop a lesson plan using the 5E Model. This model is research-based and supports inquiry-based learning, helping students build a deep understanding of both math and science. Your lesson should include:

- Engage: A hook to spark curiosity and activate prior knowledge.
- Explore: Hands-on activities that encourage students to collect and analyze data.
- Explain: Guided discussions to help students make sense of their observations.
- Elaborate: Opportunities for students to apply their learning to new situations.
- Evaluate: Assessments to measure student understanding of both math and science concepts.

You'll also need to consider differentiation—how you'll adjust the lesson to meet the needs of diverse learners, including advanced students, struggling learners, and English language learners.

1. Selecting and Analyzing Standard Pairs

It begins with standard selection and integration by identifying connections between math and science standards for a chosen grade level and analyzing them using a "Know, Do, Understand" framework and comprehensive standards analysis table.

The "Know, Do, Understand" framework is widely used in curriculum design and assessment to foster deeper learning and competency development. When applied to standard analysis, this framework helps clarify what students should know, be able to do, and understand as a result of engaging with a learning target or objective.

Know (Content: Essential Knowledge)	Do (Curricular Competencies: Skills and Actions)	Understand (Big Ideas: Enduring Understandings)
• Identify the key facts, concepts, and information that students need to learn. • Examples: Specific dates, definitions, formulas, facts, or foundational knowledge relevant to the standard. • Purpose: This step ensures students have the necessary background and factual base to engage with more complex ideas and tasks. Key Questions to Ask: What key information or concepts must students know to meet this standard?	• Determine the skills, processes, and actions students must demonstrate. • Examples: Analyzing, comparing, synthesizing, creating, problem-solving, or applying knowledge in new contexts. • Purpose: This step focuses on what students can do with their knowledge, emphasizing application, critical thinking, and practical competencies. • Assessment considerations: Students may demonstrate these competencies through various tasks and activities, not just one specific assignment. Key Questions to Ask: What should students be able to do with their knowledge?	• Explore the overarching concepts, principles, and generalizations that students should grasp. • Examples: Big ideas, themes, or enduring understandings that connect and transcend individual facts and skills. • Purpose: This step ensures students develop deeper insights that are transferable across contexts and time, fostering long-term retention and meaningful learning. • Connection to practice: Students are encouraged to make connections between new and prior knowledge, and to see patterns and relationships in what they learn. Key Questions to Ask: What deeper meaning or connections should students understand as a result?

Example:

4.OA.2: Students need to solve word problems involving multiplicative comparison using multiplication or division. They should use drawings or equations with a symbol for the unknown number to represent the problem.

Know:

- The meaning of multiplication and division.
- How to write and interpret multiplication equations (e.g., 7×3 means 7 groups of 3 units in each one group).
- The vocabulary: "times as many as," "product unknown," "partition unknown."

Do:

- Solve word problems like:
  "John says that he is thinking of a number that is 7 times bigger than 3. Write an equation to express the relationship."
- Draw models or write equations to represent the problem.
- Use mental computation and estimation to check the reasonableness of answers.

Understand:

- Multiplication is not just repeated addition but also describes relationships between quantities.
- Multiplicative comparison is a fundamental concept in algebra and real-world problem solving.
- The ability to justify and explain why a particular equation represents the situation.

Learning Targets/Objectives: “I can” statement

- I can solve real world problems that require me to multiply and divide whole numbers.
- I can solve word problems involving multiplication and division by using drawings.
- I can solve word problems involving multiplication and division by using equations and a symbol for an unknown.
- I can explain the difference between a multiplicative comparison and an additive comparison.

This initial phase culminates in developing a detailed lesson plan following the 5E instructional model.

2. Develop an integrated mathematics and science lesson plan using the 5E Instructional Model.

You'll be using the 5E Instructional Model—Engage, Explore, Explain, Elaborate, and Evaluate—to structure your lesson. This model is designed to support inquiry-based learning and help students build a deep understanding of both math and science concepts. Your lesson should demonstrate a deep understanding of both content areas and use effective pedagogical approaches to engage students.

Let's break down the components of this assignment.

a. Lesson Foundation

First, you'll establish the foundation of your lesson plan. Using the standards you selected in Part 1-1, you'll:

- Use the paired set of math and science standards from Part 1-1.
- Review your unpacking of the standards to ensure you have a clear understanding of what students need to know, do, and understand.

You'll also fill out a Lesson Foundation Table, which includes:

- Teacher Name: Your name.
- Title of Lesson: A creative and descriptive title for your lesson.
- Grade Level: The grade level you're teaching (3-5).
- Time Frame: The total duration of the lesson.
- Standards: The math and science standards you're integrating.
- Essential Questions: 1 question that will drive student inquiry and demonstrate the interconnected nature of math and science.
- Learning Targets/Student Learning Objectives: Clear, measurable "I can" statements that describe what students will be able to do by the end of the lesson.
- Prior Knowledge Required: What students should already know in both math and science before starting this lesson.
- Materials and Resources: A list of materials you'll need, including teacher materials, student materials, safety considerations, and technology needs.

b. 5E Lesson Development

This is the heart of your lesson plan. You'll design your lesson using the 5E Instructional Model, ensuring that math and science are meaningfully integrated throughout each phase. Let's go through each phase of the 5E model:

Engage

- Create an engaging hook that sparks curiosity in both math and science concepts.
- Activate prior knowledge in both subject areas.
- Present a phenomenon or problem that integrates both disciplines.
- Assess students' preconceptions about both math and science content.

Explore

- Design hands-on investigations that require both mathematical and scientific thinking.
- Provide structured opportunities for students to collect and organize data.
- Include guided inquiry activities that help students discover relationships between math and science concepts.
- Create student-centered experiences that encourage questioning and exploration.

Explain

- Guide students in making sense of their observations using both mathematical and scientific vocabulary.
- Help students recognize patterns and relationships between the two disciplines.
- Facilitate student explanations of concepts using evidence from their exploration.
- Introduce formal terminology and concepts that bridge both subjects.

Elaborate

- Provide opportunities for students to apply their learning to new situations.
- Create connections between the integrated concepts and real-world applications.
- Challenge students to extend their understanding through additional problems or scenarios.
- Encourage students to make connections across different contexts.

Evaluate

- Assess understanding of both math and science concepts.
- Create opportunities for students to demonstrate their grasp of the relationships between both subjects.
- Include both formal and informal assessment strategies.
- Encourage student self-reflection on their learning in both content areas.

c. Supporting Components

In addition to the 5E lesson plan, you'll need to address two key supporting components: differentiation and assessment.

Differentiation Plan:

You'll need to consider how you'll differentiate instruction to meet the needs of diverse learners. Your class profile includes:

- Advanced Learners
- Struggling Learners
- Language Learners
- Students with IEPs

Provide at least two specific examples of accommodations and modifications you'll make during the lesson to support each learner.

Assessment:

You'll also need to describe how you'll monitor and assess student understanding throughout the lesson. This includes:

- Pre-Assessment: How you'll assess students' prior knowledge before the lesson begins.
- Formative Assessment: Strategies for checking understanding during each phase of the lesson (Engage, Explore, Explain, Elaborate).
- Summative Assessment: How you'll evaluate student learning at the end of the lesson.