NM STEM Ready! Science Standards Implementation Guide

Overview

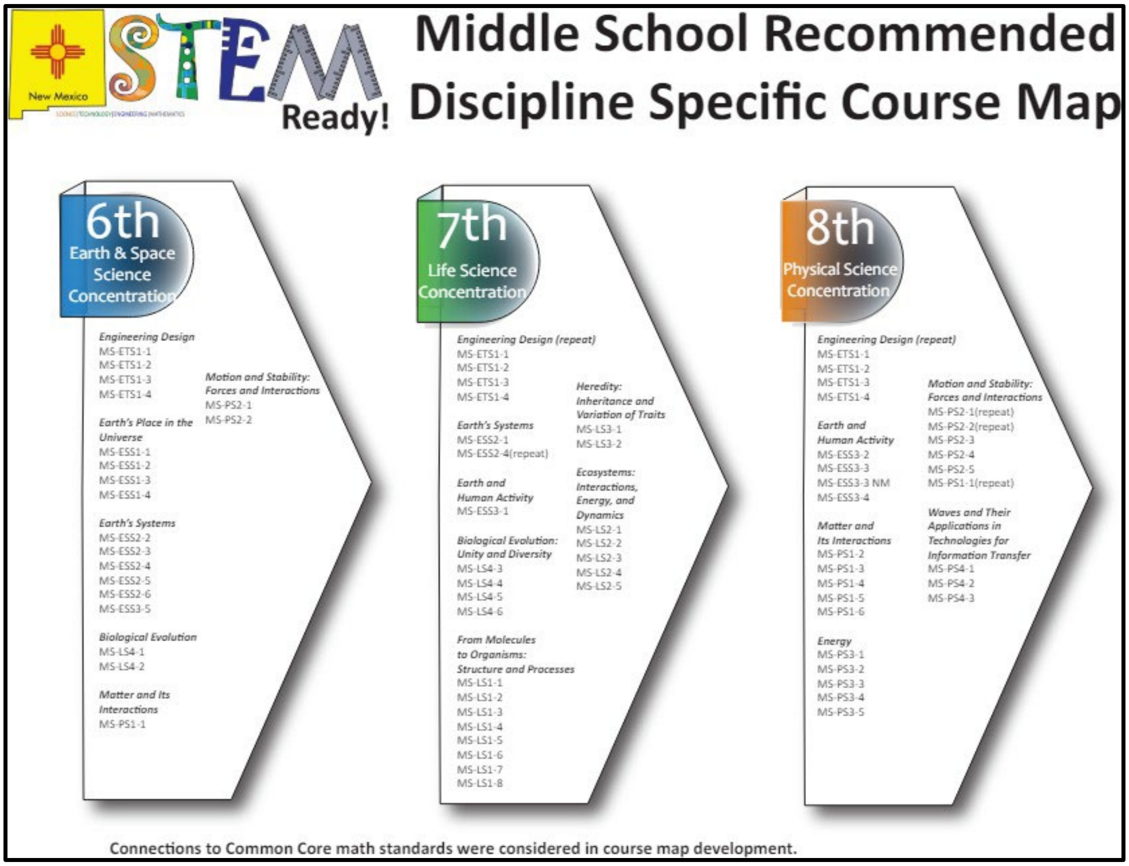
A Framework for K–12 Science Education marks a leap forward in how we think about science education and captures the advancements made in understanding how students best learn science that have been made over the last 30 years. The New Mexico Public Education Department (PED) and New Mexico public school teachers worked together over the course of spring 2024 to construct an updated Instructional Scope 2.0 document for the New Mexico STEM Ready! Science Standards.

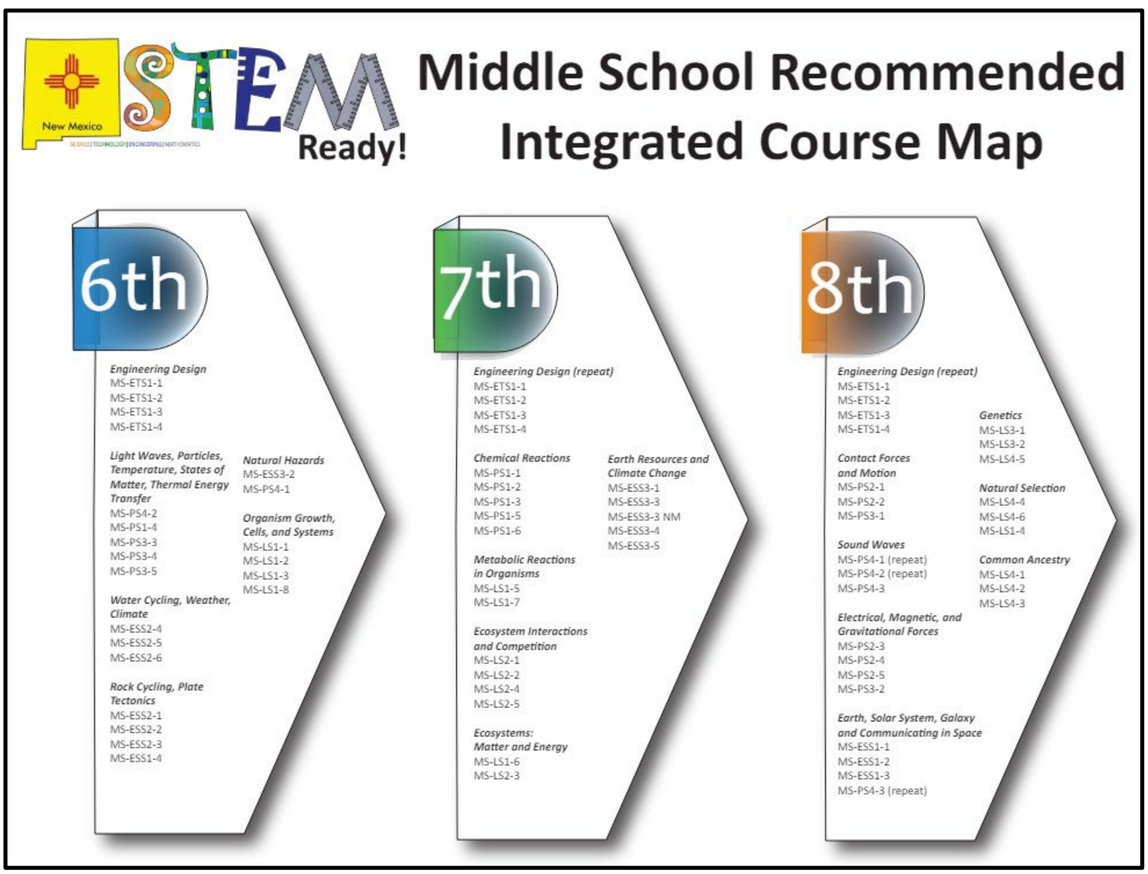
There are many public schools where high-quality instructional materials (HQIM) are present, and these should be used in the teaching of science. The updated 2.0 Instructional Scope includes some reference to the high-quality instructional materials (HQIM) used in the state, but also has updated sections that may be beneficial if they are not included with HQIM, like New Mexico relevant science phenomena and New Mexico's Multi-Layered Systems of Support (MLSS) section. It is recommended that schools with adopted HQIM continue to use their materials, but also reference the updated 2.0 Instructional Scope for context to better support New Mexico students.

New Mexico science teachers worked collaboratively to identify and construct an updated template, common misconceptions, sample phenomena, classroom assessment items, culturally and linguistically responsive (CLR) instructional strategies, Universal Design for Learning (UDL) strategies, MLSS, and cross-curricular connections for each performance expectation in the New Mexico STEM Ready! Science Standards.

The best practice of bundling related standards together to capture multiple aspects of a single phenomenon was not done, as local educational agencies (LEAs) should determine how best to bundle New Mexico STEM Ready! Science Standards based on their needs.

The standards are separated into their different disciplines and provided in a sequential format (EX: MS-PS1-1, MS-PS2-3, MS-ETS1-1), however, these standards are not meant to be taught individually on their own but bundled with other standards. Bundles are groups of standards arranged together to create endpoints for instruction and helps students see connections between concepts and allow more efficient use of instructional time. Work with your local school, or district, on creating bundles for your science courses or you can utilize resources and guidance from PED, such as the recommended discipline specific or integrated course maps (see images below).


New Mexico
STEM Ready!
Middle School Recommended Discipline Specific Course Map
6th
Earth & Space Science Concentration
Engineering Design
MS-ETS1-1
MS-ETS1-2
MS-ETS1-3
MS-ETS1-4
Earth's Place in the Universe
MS-ESS1-1
MS-ESS1-2
MS-ESS1-3
MS-ESS1-4
Earth's Systems
MS-ESS2-2
MS-ESS2-3
MS-ESS2-4
MS-ESS2-5
MS-ESS2-6
MS-ESS3-5
Biological Evolution
MS-LS4-1
MS-LS4-2
Matter and Its Interactions
MS-PS1-1
Motion and Stability: Forces and Interactions
MS-PS2-1
MS-PS2-2
7th
Life Science Concentration
Engineering Design (repeat)
MS-ETS1-1
MS-ETS1-2
MS-ETS1-3
MS-ETS1-4
Earth's Systems
MS-ESS2-1
MS-ESS2-4(repeat)
Earth and Human Activity
MS-ESS3-1
Biological Evolution: Unity and Diversity
MS-LS4-3
MS-LS4-4
MS-LS4-5
MS-LS4-6
From Molecules to Organisms: Structure and Processes
MS-LS1-1
MS-LS1-2
MS-LS1-3
MS-LS1-4
MS-LS1-5
MS-LS1-6
MS-LS1-7
MS-LS1-8
Heredity: Inheritance and Variation of Traits
MS-LS3-1
MS-LS3-2
Ecosystems: Interactions, Energy, and Dynamics
MS-LS2-1
MS-LS2-2
MS-LS2-3
MS-LS2-4
MS-LS2-5
8th
Physical Science Concentration
Engineering Design (repeat)
MS-ETS1-1
MS-ETS1-2
MS-ETS1-3
MS-ETS1-4
Earth and Human Activity
MS-ESS3-2
MS-ESS3-3
MS-ESS3-3 NM
MS-ESS3-4
Matter and Its Interactions
MS-PS1-2
MS-PS1-3
MS-PS1-4
MS-PS1-5
MS-PS1-6
Energy
MS-PS3-1
MS-PS3-2
MS-PS3-3
MS-PS3-4
MS-PS3-5
Motion and Stability: Forces and Interactions
MS-PS2-1(repeat)
MS-PS2-2(repeat)
MS-PS2-3
MS-PS2-4
MS-PS2-5
MS-PS1-1(repeat)
Waves and Their Applications in Technologies for Information Transfer
MS-PS4-1
MS-PS4-2
MS-PS4-3
Connections to Common Core math standards were considered in course map development.


New Mexico
STEM Ready!
Middle School Recommended Integrated Course Map
6th
Engineering Design
MS-ETS1-1
MS-ETS1-2
MS-ETS1-3
MS-ETS1-4
Light Waves, Particles, Temperature, States of Matter, Thermal Energy Transfer
MS-PS4-2
MS-PS1-4
MS-PS3-3
MS-PS3-4
MS-PS3-5
Water Cycling, Weather, Climate
MS-ESS2-4
MS-ESS2-5
MS-ESS2-6
Rock Cycling, Plate Tectonics
MS-ESS2-1
MS-ESS2-2
MS-ESS2-3
MS-ESS1-4
Natural Hazards
MS-ESS3-2
MS-PS4-1
Organism Growth, Cells, and Systems
MS-LS1-1
MS-LS1-2
MS-LS1-3
MS-LS1-8
7th
Engineering Design (repeat)
MS-ETS1-1
MS-ETS1-2
MS-ETS1-3
MS-ETS1-4
Chemical Reactions
MS-PS1-1
MS-PS1-2
MS-PS1-3
MS-PS1-5
MS-PS1-6
Metabolic Reactions in Organisms
MS-LS1-5
MS-LS1-7
Ecosystem Interactions and Competition
MS-LS2-1
MS-LS2-2
MS-LS2-4
MS-LS2-5
Ecosystems: Matter and Energy
MS-LS1-6
MS-LS2-3
Earth Resources and Climate Change
MS-ESS3-1
MS-ESS3-3
MS-ESS3-3 NM
MS-ESS3-4
MS-ESS3-5
8th
Engineering Design (repeat)
MS-ETS1-1
MS-ETS1-2
MS-ETS1-3
MS-ETS1-4
Contact Forces and Motion
MS-PS2-1
MS-PS2-2
MS-PS3-1
Sound Waves
MS-PS4-1 (repeat)
MS-PS4-2 (repeat)
MS-PS4-3
Electrical, Magnetic, and Gravitational Forces
MS-PS2-3
MS-PS2-4
MS-PS2-5
MS-PS3-2
Earth, Solar System, Galaxy and Communicating in Space
MS-ESS1-1
MS-ESS1-2
MS-ESS1-3
MS-PS4-3 (repeat)
Genetics
MS-LS3-1
MS-LS3-2
MS-LS4-5
Natural Selection
MS-LS4-4
MS-LS4-6
MS-LS1-4
Common Ancestry
MS-LS4-1
MS-LS4-2
MS-LS4-3

The Standards

Each performance expectation (PE) begins with links to the *Next Generation Science Standards* and a snapshot of the performance expectation with the relevant Science and Engineering Practices (SEP), Disciplinary Core Ideas (DCI), and Cross Cutting Concepts (CCC). Also captured are the connections across the grade level or band (horizontal), connections across grade levels or bands (vertical), and connections to the *Common Core State Standards* (CCSS) in math and English language arts.

The Performance Expectation (PE) describes what a student is expected to be able to do at the completion of instruction. They are intended to guide the development of assessments, but they are not the assessment as such. They are not instructional strategies or instructional objectives, but they should influence and guide instruction. Most performance expectations contain a clarification statement and an assessment boundary statement to provide clarity to the performance expectation and guidance to the scope of the expectation, respectively.[1]

The foundation box, which is located below the PE, contains the learning goals that students should achieve and that will be assessed using the PED. The three parts to the foundation box are the science and engineering practices, the disciplinary core ideas, and the crosscutting concepts. The information contained in the foundation box is taken directly from *A Framework for K–12 Science Education*. Also included in the foundation box, where appropriate, are connections to engineering, technology, and applications of science as well as connections to the nature of science. These supplemental goals are related to the other material in the foundation box and are intended to guide instructions, but the outcomes are not included in the performance expectation.

The connections box identifies connections to other disciplinary core ideas at this grade level that are relevant to the standard, identifies the articulation of disciplinary core ideas across grade levels, and identifies connections to the CCSS in mathematics and in English language arts and literacy that align to this standard. The connections box helps support instruction and development of instructional materials.

[1] Pratt, Harold (2013) *The NSTA Reader's Guide to the Next Generation Science Standards*

Common Misconceptions

What: This planning support identifies some of the common misconceptions students develop about a scientific topic.

Why: Our brains are highly advanced cause and effect reasoning machines. From birth, we begin to analyze effects to determine causes and provide some sort of reasoning for the whole event. The more events that support our reasoning, the stronger that learning becomes. So, every student in your classroom brings their own unique background knowledge into your classroom. Some of this is aligned to scientific understanding and some of this is misaligned to scientific understanding but aligned to that student's personal experiences. As science educators, we must always create space for students to bring their current understanding about a topic into our classroom so that we can begin to address understandings that are misaligned to scientific understanding. Some of these misunderstandings are not unique to a single student; rather, they are common to many students.

How: When planning with your HQIM look for ways to directly address with students some common misconceptions. The planning supports in this document provide some possible misconceptions and your HQIM might include additional ones. The goal is not to avoid misconceptions, they are a natural part of the learning process, but we want to support students in exploring the misconception and modifying incorrect or partial understandings.

Sample Phenomena and New Mexico Relevant Phenomena

Located directly under the standards and misconceptions are the suggested sample phenomena. This section was constructed specifically for New Mexico with suggestions for phenomena that are relevant to New Mexico or relatable by New Mexico students..

What: Natural phenomena are observable events that occur in the universe and that we can use our science knowledge to explain or predict. The goal of building knowledge in science is to develop general ideas, based on evidence, that can explain and predict phenomena. Engineering involves designing solutions to problems that arise from phenomena and using explanations of phenomena to design solutions. In this way, phenomena are the context for the work of both the scientist and the engineer.

Why: Despite their centrality in science and engineering, phenomena have traditionally been a missing piece in science education. Anchoring learning in explaining phenomena supports student agency for wanting to build science and engineering knowledge. Students are able to identify an answer to "why do I need to learn this?" before they even know what "this" is. By centering science education on phenomena that students are motivated to explain, the focus of learning shifts from learning about a topic to figuring out why or how something happens. Explaining phenomena and designing solutions to problems allow students to build general science knowledge in the context of their application to understanding phenomena in the real world, leading to deeper and more transferable knowledge. Students who come to see how science ideas can help explain and model phenomena related to compelling real-world situations learn to appreciate the social relevance of science. They get interested in and identify with science as a way of understanding and improving real-world contexts.

Learning to explain phenomena and solve problems is the central reason students engage in the three dimensions of the *NGSS*. Students explain phenomena by developing and applying the DCI and CCC through use of the SEPs. Phenomena-centered classrooms also give students and teachers a context in which to monitor ongoing progress toward understanding all three dimensions. As students are working toward being able to explain phenomena, three-dimensional formative assessment becomes more easily embedded and coherent throughout instruction.

<u>How:</u> We use phenomena to drive instruction to help students engage in practices to develop the knowledge necessary to explain or predict the phenomena. Therefore, the focus is not just on the phenomenon itself. It is the phenomenon plus the student-generated questions about the phenomenon that guides the learning and teaching. The practice of asking questions or identifying problems becomes a critical part of trying to figure something out.

There could potentially be many different lines of inquiry about the same phenomenon. Teachers should help students identify different aspects of the same phenomenon as the focus of their questions. Students also might ask questions about a phenomenon that motivates a line of investigation that isn't grade appropriate or might not be effective at using or building important disciplinary ideas. Teacher guidance may be needed to help students reformulate questions so they can lead to grade appropriate investigations of important science ideas.

It is important that all students—including English Learners and students from cultural groups underrepresented in STEM—are supported in working with phenomena that are engaging and meaningful to them. Not all students will have the same background or relate to a particular phenomenon in the same way. Educators should consider student perspectives when choosing phenomena and should prepare to support student engagement in different ways. When starting with one phenomenon in your classroom, it is always a good idea to help students identify related phenomena from their lives and their communities to expand the phenomena under consideration.

Not all phenomena need to be used for the same amount of instructional time. Teachers could use an anchoring phenomenon as the overall focus for a unit, along with other investigative phenomena along the way as the focus of an instructional sequence or lesson. They may also highlight everyday phenomena that relate investigative or anchoring phenomena to personally experienced situations. A single phenomenon doesn't have to cover an entire unit, and different phenomena will take different amounts of time to figure out.

The most powerful phenomena are culturally or personally relevant or consequential to students. Such phenomena highlight how science ideas help us explain aspects of real-world contexts or design solutions to science-related problems that matter to students, their communities, and society. An appropriate phenomenon for instruction should help engage all students in working toward the learning goals of instruction as described by the DCIs, SEPs, and CCCs in the foundation box of the standard.

The process of developing an explanation for a phenomenon should advance students' understanding. If students already need to know the target knowledge before they can inquire about the phenomenon, then the phenomenon is not appropriate for initial instruction. Students should be able to make sense of anchoring or investigative phenomena, but not immediately, and not without investigating it using sequences of the science and engineering practices. Phenomena do not need to be flashy or unexpected. Students might not be intrigued by an everyday phenomenon right away because they believe they already know how or why it happens. With careful teacher facilitation, students can become dissatisfied with what they believe they already know and strive to understand it in the context of the DCI that the teacher is targeting.[2]

Classroom Assessment Items

To align with the phenomena section above, this includes New Mexico based assessment items that directly relate, or comparatively, to the suggested New Mexico phenomena when available.

What: Classroom assessments (sometimes referred to as internal assessments) is used to refer to assessments designed or selected by teachers and given as an integral part of classroom instruction. This category of assessment may include teacher-student interactions in the classroom, observations of students, student products that result directly from ongoing instructional activities, quizzes tied to instructional activities, formal classroom exams that cover material from one or more instructional units, or assessments created by curriculum developers and embedded in instructional materials for teacher use.[3]

Classroom assessments can be designed to guide instruction (formative purposes) or to support decisions made beyond the classroom (summative purposes). Assessments used for formative purposes occur during the course of a unit of instruction and may involve both formal tests and informal activities conducted as part of a lesson. They may be used to identify students' strengths and weaknesses, assist students in guiding their own learning, and foster students' sense of autonomy and responsibility for their own learning. Assessments for summative purposes may be administered at the end of a unit of instruction. They are designed to provide evidence of achievement that can be used in decision making, such as assigning grades, making promotion or retention decisions, and classifying test takers according to defined performance categories. The results of all these assessments are evaluated by the teacher or sometimes by groups of teachers. These assessments play an integral role in students' learning experiences while also providing evidence of progress in that learning.

Why: In *Developing Assessments for the Next Generation Science Standards*, the National Research Council shared the following conclusions regarding assessing three-dimensional learning[4]:

- Measuring the three-dimensional science learning called for in the framework and the NGSS requires assessment tasks that examine students' performance of scientific and engineering practices in the context of crosscutting concepts and disciplinary core ideas. To adequately cover the three dimensions, assessment tasks will generally need to contain multiple

[2] Penuel, W. R., Bell, P., Neill, T., Morrison, D., & Tesoriero, G. (2018). *Selecting Anchoring Phenomena for Equitable 3D Teaching*. [OER Professional Development Session from the ACESSE Project] Retrieved from http://stemteachingtools.org/pd/sessione

[3] National Resource Council. (2014). *Developing Assessments for the Next Generation Science Standards.* Committee on Developing Assessments of Science Proficiency in K-12. Board on Testing and Assessments and Board on Science Education, J.W. Pellegrino, M.R. Wilson, J.A. Koenig, and A.S. Beatty, *Editors*. Division of Social Sciences and Education. Washington, DC: The National Academies Press.

[4] National Research Council. (2014). *Developing Assessments for the Next Generation Science Standards.* Committee on Developing Assessments of Science Proficiency in K-12. Board on Testing and Assessment and Board on Science Education. J.W. Pellegrino, M.R. Wilson, J.A. Koenig, and A.S. Beatty, *Editors*. Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

[5] STEM Teaching Tools (n.d.), http://stemteachingtools.org/tools accessed on July 7, 2021

components. It may be useful to focus on individual practices, core ideas, or crosscutting concepts in the various components of an assessment task, but, together, the components need to support inferences about students' three-dimensional science learning as described in a given performance expectation.

- The Next Generation Science Standards require that assessment tasks be designed so they can accurately locate students along a sequence of progressively more complex understandings of a core idea and successively more sophisticated applications of practices and crosscutting concepts.

- The NGSS places significant demands on science learning at every grade level. It will not be feasible to assess all the performance expectations for a given grade level with any one assessment. Students will need multiple – and varied – assessment opportunities to demonstrate their competence on the performance expectations for a given grade level.

- Effective evaluation of three-dimensional science learning requires more than a one-to-one mapping between the NGSS performance expectations and assessment tasks. More than one assessment task may be needed to adequately assess students' mastery of some performance expectations, and any given assessment task may assess aspects of more than one performance expectations. In addition, to assess both understanding of core knowledge and facility with a practice, assessments may need to probe students' use of a given practice in more than one disciplinary context. Assessment tasks that attempt to test practices in strict isolation from one another may not be meaningful as assessments of the three-dimensional science learning called for by the NGSS. (Developing assessments for NGSS, NRC, pp.44-46)

How: The amount of information that has been generated around designing and creating three-dimensional assessment tasks to meet the conclusions laid out above by the National Research Council has been overwhelming. The following free resources are available through STEM teaching tools to help you navigate this flood of information and translate it into your classroom. You should start by familiarizing yourself with the STEM Teaching Tools[5]: http://stemteachingtools.org/tools

- Practice Brief 18 on how teachers can develop formative assessments that fit a three-dimensional view of science learning.
- Practice Brief 26 on how to design formative assessments that engage students in three-dimensional learning.
- Practice Brief 30 on integrating science practices into assessment tasks
- Practice Brief 41 on integrating cross cutting concepts into assessment and instruction
- Practice Brief 33 on designing assessments for emerging bilingual students

Culturally and Linguistically Responsive Instruction

What: Culturally and Linguistically Responsive Instruction (CLRI), or the practice of situational appropriateness, requires educators to contribute to a positive school climate by validating and affirming students' home languages and cultures. Validation is making the home culture and

[5] STEM Teaching Tools (n.d.), http://stemteachingtools.org/tools accessed on July 7, 2021

language legitimate, while affirmation is affirming or making clear that the home culture and language are positive assets. It is also the intentional effort to reverse negative stereotypes of non-dominant cultures and languages and must be intentional and purposeful, consistent and authentic, and proactive and reactive. Building and bridging is the extension of validation and affirmation. By building and bridging students learning to toggle between home culture and linguistic behaviors and expectations and the school culture and linguistic behaviors and expectations. The building component focuses on creating connections between the home culture and language and the expectations of school culture and language for success in school. The bridging component focuses on creating opportunities to practice situational appropriateness or utilizing appropriate cultural and linguistic behaviors. It is essential to recognize the impact of language in accessing the learning and guidance for linguistic vocabulary support are provided.

Why: Student understanding of science is shaped by their interactions with phenomena throughout their lives. Science educators must intentionally and purposefully legitimize the home culture and languages of students and validate their ways of knowing and understanding. In addition, create connections between the cultural and linguistic behaviors of the students' home culture and language and the culture and language of scientific understanding.

How: When planning instruction it is critical to consider ways to validate/affirm and build/bridge from your students' cultural and linguistic assets. There has been an overwhelming amount of guidance within STEM education about CLRI. The following STEM Teaching Tools can be a good place to start wrapping your mind around this topic[6].

- Practice Brief 15: Promoting equity in science education
- Practice Brief 47: Promoting equitable sensemaking
- Practice Brief 54: Building equitable learning communities
- Practice Brief 11: Indigenous ways of knowing and STEM
- Practice Brief 27: Engaging English language learners in science and engineering practices
- Practice Brief 71: Advancing equity and justice in science education
- Practice Brief 53: Avoiding pitfalls associated with CLRI

The planning supports for each performance expectation provide an example of how to support equity-based teaching practices. Look for additional ways within your HQIM to ensure all students are included in the pursuit of scientific understanding in your classroom.

Multi Layered System of Supports (MLSS)

The Multi-Layered Systems of Support (MLSS) has been updated to include instructional, social-emotional, and behavioral supports for layers 1, 2, and 3. While not all supports can be listed to meet the needs of all students, general suggestions are provided for guidance. Work within your local control to best meet the needs of your students.

What: The Multi-Layered Systems of Support (MLSS) is designed to support teachers in planning instruction for the needs of all students. Each section identifies general supports (layer 1) for supporting pedagogically sound whole class science instruction, targeted supports (layer 2) for supporting those scholars that teachers identify as not understanding the topic, and students needing intensive support (layer 3) for those students needing longer duration or otherwise more

[6] STEM Teaching Tools (n.d.), http://stemteachingtools.org/tools accessed on July 7, 2021

intense support through small group instruction.

Why: MLSS is a holistic framework that guides educators, those closest to the student, to intervene quickly when students need additional support. The framework moves away from the "wait to fail" model and empowers teachers to use their professional judgement to make data-informed decisions regarding the students in their classroom to ensure academic success with grade level expectations of the New Mexico Science Standards.

How: When planning with your high-quality instructional materials (HQIM) use the suggested universal supports embedded in the sequence of instruction. If you do not have access to HQIM in your school, the universal (layer 1) support in this document can be used in planning your instruction.

Cross-Curricular Connections

The very last section of the Instructional Scope is the cross-curricular connections. These include math and literacy standards that are supplied for the performance expectation of each standard, as well as career connections for relevant job connections.

What: In order to provide guidance on cross-curricular instruction, the standards are identified for common core English language arts (ELA) and mathematics. When reading the CCSS in mathematics and English language arts (ELA), consider the following questions:

- Should students have achieved these mathematics and ELA standards to engage in the learning of science, or could they be learned together?
- In what ways do the referenced mathematics and ELA standards help clarify the science performance expectations?
- Can any of the science core ideas be included as examples in the mathematics or ELA instruction?

Why: The cross-curricular connections utilizes common core ELA and mathematics standards identified in NGSS and provides suggestions for use within instruction so teachers are better able to see how these connections might live within their instruction.

How: When planning with your high-quality instructional materials (HQIM) use the suggested cross-curricular connections embedded in the sequence of instruction. If you do not have access to HQIM in your school, utilize the suggestions in this document that can be used in planning your instruction.