Tools for Supporting NGSS Alignment and Implementation

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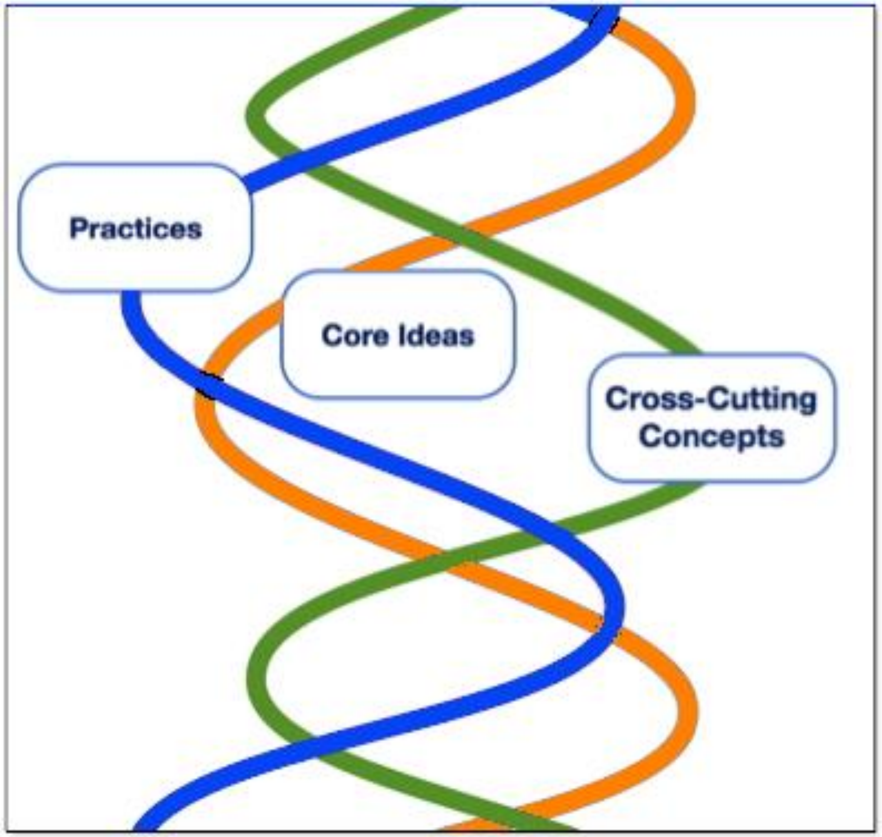
STEM Smart workshops are funded by the National Science Foundation grant #1449550. Any opinions, findings, and conclusions or recommendations at this event or in these materials are those of the author(s) and do not necessarily reflect the views of the National Science Foundation

About Achieve

- Committed to ensuring all students graduate from high school “college and career ready” so students are academically prepared for next steps after high school.
- Work with states to raise academic standards and graduation requirements, improve assessments, and strengthen accountability systems.
- Partner with state governments, reform agencies, policy organizations, and other stakeholders to conduct research, provide technical assistance on policy execution, develop advocacy resources, and communicate results.

Next Generation Science Standards

THREE DIMENSIONS INTERTWINED



- The NGSS are written as Performance Expectations
- NGSS will require contextual application of the three dimensions by students.
- Focus is on how and why as well as what

WHAT’S DIFFERENT ABOUT THE NEXT GENERATION SCIENCE STANDARDS?

Innovations in the NGSS

1. Three-Dimensional Learning

2. Students Engaging in Phenomena and Designed Solutions

3. Engineering and Nature of Science is integrated into science

4. All three dimensions build coherent learning progressions

5. Science is connected to math and literacy

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WHAT ARE WE LOOKING FOR?

Activity (3 minutes): individually, write down the 3-5 most important needs to support classroom implementation

(5 minutes) In small groups, discuss your ideas and share and categorize your thinking into descriptive categories. Be prepared to share out!

Current and Upcoming Resources

- EQuIP for Science
- EQuIP Facilitator's Guide
- Standards Comparison Document
- K-12 Evidence Statements
- MS and HS Classroom Sample Tasks
- Accelerated Model Course Pathways
- Video Series
  - Introduction to the NGSS
  - Classroom Videos
  - EQuIP Videos

- Model Content Frameworks
- Elementary Sample Classroom Tasks
- District Implementation Guide

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equip

Educators Evaluating
Quality Instructional Products

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The Equip Rubric <u>IS</u>	The Equip Rubric <u>IS NOT</u>
Designed to evaluate LESSONS that include instructional tasks and assessments aligned to NGSS	Designed to evaluate a single task or activity or a full curriculum
Designed to evaluate UNITS that include integrated and focused lessons aligned to the NGSS that extend over a longer period of time	Designed to require a specific template for lessons or units

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Purposes of the EQuIP Rubric

1. Review existing lessons and units to determine what revisions are needed;
2. Provide constructive criterion-based feedback and suggestions for improvement to developers;
3. Identify exemplars/models for teachers' use within and across states; and
4. Inform the development of new lessons and units.

Quality Review Process

Quality Review Process

1. NGSS
2. Inquiry
3. Respect & Commitment
4. Criteria & Evidence
5. Constructive
6. Individual to Collective
7. Understanding & Agreement

Rubric Criteria

Category I	Category II	Category III
Alignment to NGSS	**Instructional Supports**	**Monitoring Student Progress**
Three Dimensional: Supports students in three-dimensional learning to explain phenomena and/or to design solutions to problems	Supports learning for all students through meaningful scenarios, supporting practices; supports phenomena and representations	Assessments evaluate three-dimensional learning; include formative; are accessible and unbiased
Coherence: Lessons fit together coherently; develops connections	Provides guidance for teachers to build coherence across the unit	Pre-, formative, and summative aligned to three-dimensional learning

How do we employ evidence, reasoning, feedback, evaluation, and guidance when using the EQuIP Rubric to examine instructional materials?

EQuIP Rubric for Lessons & Units: Science

Reviewer Name or ID: **Grade:**
Science Lesson/Unit Title:

I. Alignment to the NGSS

The lesson or unit aligns with the conceptual shifts of the NGSS:

Criteria	Specific evidence from materials and reviewers' reasoning	Suggestions for improvement
☐ A. Grade-appropriate elements of the science and engineering practice(s), disciplinary core idea(s), and crosscutting concept(s), work together to support students in three-dimensional learning to make sense of phenomena and/or to design solutions to problems. i. Provides opportunities to use specific elements of the practice(s) to make sense of phenomena and/or to design solutions to problems. ii. Provides opportunities to construct and use specific elements of the disciplinary core idea(s) to make sense of phenomena and/or to design solutions to problems. iii. Provides opportunities to construct and use specific elements of the crosscutting concept(s) to make sense of phenomena and/or to design solutions to problems. iv. The three dimensions work together to support students to make sense of phenomena and/or to design solutions to problems.		

A unit or longer lesson will also:

Criteria	Specific evidence from materials and reviewers' reasoning	Suggestions for improvement
☐ B. Lessons fit together coherently targeting a set of performance expectations. i. Each lesson links to previous lessons and provides a need to engage in the current lesson. ii. The lessons help students develop proficiency on a targeted set of performance expectations.		
☐ C. Where appropriate, disciplinary core ideas from different disciplines are used together to explain phenomena.		
☐ D. Where appropriate, crosscutting concepts are used to explain phenomena from a variety of disciplines.		
☐ E. Provides grade-appropriate connection(s) to the Common Core State Standards in Mathematics and/or English Language Arts & Literacy in History/Social Studies, Science and Technical Subjects.		

If the lesson or unit is not closely aligned to the Next Generation Science Standards, it may not be appropriate to move on to the second and third categories. Professional judgment should be used when weighing the individual criterion. For example, a lesson without crosscutting concepts explicitly called out may be easier to revise than one without appropriate disciplinary core ideas; such a difference may determine whether reviewers believe the lesson merits continued evaluation or not.

I can see it, point to it in a lesson or unit, highlight it, or quote it directly from what is written.

Use reasoning to explain how the pieces of evidence connect to the rubric criteria.

Three-Dimensional Learning

Simply said,

- 3-D learning engages students in using scientific and engineering practices and applying cross-cutting concepts as tools to develop understanding of and solve challenging problems related to disciplinary core ideas.

Three-Dimensional Learning

A. Grade-appropriate elements of the science and engineering practice(s), disciplinary core idea(s), and crosscutting concept(s), work together to support students in three-dimensional learning to make sense of phenomena and/or to design solutions to problems.

   i. Provides opportunities to develop and use specific elements of the practice(s) to make sense of phenomena and/or to design solutions to problems.

   ii. Provides opportunities to develop and use specific elements of the disciplinary core idea(s) to make sense of phenomena and/or to design solutions to problems.

   iii. Provides opportunities to develop and use specific elements of the crosscutting concept(s) to make sense of phenomena and/or to design solutions to problems.

   iv. The three dimensions work together to support students to make sense of phenomena and/or to design solutions to problems.

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Foundation Boxes

Students who demonstrate understanding can:

5-PS3-1. **Use models to describe that that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.** [Clarification Statement: Examples of models could include diagrams, and flow charts.]

5-LS1-1. **Support an argument that plants get the materials they need for growth chiefly from air and water.** [Clarification Statement: Emphasis is on the idea that plant matter comes mostly from air and water, not from the soil.]

5-LS2-1. **Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.** [Clarifcation Statement: Emphasis is on the idea that matter that is not food (air, water, decomposed materials in soil) is changed by plants into matter that is food. Examples of systems could include organisms, ecosystems, and the Earth.] [Assessment Boundary: Assessment does not include molecular explanations.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Use models to describe phenomena. (5-PS3-1) • Develop a model to describe phenomena. (5-LS2-1) **Engaging in Argument from Evidence** Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Support an argument with evidence, data, or a model. (5-LS1-1) - ***Connections to the Nature of Science*** **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** • Science explanations describe the mechanisms for natural events. (5-LS2-1)	**PS3.D: Energy in Chemical Processes and Everyday Life** • The energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water). (5-PS3-1) **LS1.C: Organization for Matter and Energy Flow in Organisms** • Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion. *(secondary to 5-PS3-1)* • Plants acquire their material for growth chiefly from air and water. (5-LS1-1) **LS2.A: Interdependent Relationships in Ecosystems** • The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials	**Systems and System Models** • A system can be described in terms of its components and their interactions. (5-LS2-1) **Energy and Matter** • Matter is transported into, out of, and within systems. (5-LS1-1) • Energy can be transferred in various ways and between objects. (5-PS3-1)

Appendices

Practice 1 Asking Questions and Defining Problems

Students at any grade level should be able to ask questions of each other about the texts they read, the features of the phenomena they observe, and the conclusions they draw from their models or scientific investigations. For engineering, they should ask questions to define the problem to be solved and to elicit ideas that lead to the constraints and specifications for its solution. (NRC Framework 2012, p. 56)

Scientific questions arise in a variety of ways. They can be driven by curiosity about the world, inspired by the predictions of a model, theory, or findings from previous investigations, or they can be stimulated by the need to solve a problem. Scientific questions are distinguished from other types of questions in that the answers lie in explanations supported by empirical evidence, including evidence gathered by others or through investigation.

While science begins with questions, engineering begins with defining a problem to solve. However, engineering may also involve asking questions to define a problem, such as: What is the need or desire that underlies the problem? What are the criteria for a successful solution? Other questions arise when generating ideas, or testing possible solutions, such as: What are the possible trade-offs? What evidence is necessary to determine which solution is best?

Asking questions and defining problems also involves asking questions about data, claims that are made, and proposed designs. It is important to realize that asking a question also leads to involvement in another practice. A student can ask a question about data that will lead to further analysis and interpretation. Or a student might ask a question that leads to planning and design, an investigation, or the refinement of a design.

Whether engaged in science or engineering, the ability to ask good questions and clearly define problems is essential for everyone. The following progression of Practice 1 summarizes what students should be able to do by the end of each grade band. Each of the examples of asking questions below leads to students engaging in other scientific practices.

Grades K-2	Grades 3-5	Grades 6-8	Grades 9-12
Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. • Ask questions based on observations to find more information about the natural and/or designed world(s). • Ask and/or identify questions that can be answered by an investigation. • Define a simple problem that can be solved through the	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. • Ask questions about what would happen if a variable is changed. • Identify scientific (testable) and non-scientific (non-testable) questions. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. • Use prior knowledge to describe problems that can be solved. • Define a simple design	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. • Ask questions o that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information. o to identify and/or clarify evidence and/or the premise(s) of an argument. o to determine relationships between independent and dependent variables and relationships in models. o to clarify and/or refine a model, an explanation, or an engineering problem.	Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. • Ask questions o that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information. o that arise from examining models or a theory, to clarify and/or seek additional information and relationships. o to determine relationships, including quantitative

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Let's Look for Evidence of 3-D Learning

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Observing a Chemical Reaction

Purpose: In this lab experiment you will observe that when a chemical reaction occurs the materials that are formed have new properties from those of the starting materials.

Background knowledge: When a chemical reaction occurs, the products that form have different properties than the initial materials.

Materials for each group:

- 1 baggie with zip seal
- 1 plastic spoon
- 1 25-ml graduated cylinder
- 1 film canister or small container
- 1 plastic spoonful of sodium bicarbonate (baking soda)
- 2 plastic spoonfuls of calcium chloride (road salt)

Safety:

Wear goggles at all times

Wash your hands after you finish the investigation.

Procedure

1. Recall the solubility data about baking soda and road salt from Lesson 2. Both baking soda and road salt are soluble.
2. Observed what the baking soda looks like and record the information in your table.
3. Place 1tsp of the baking soda in the plastic bag.
4. Observed what the rock salt looks like and record the information in your table.
5. Place 2tsp of road salt into a plastic bag.
6. Observe if anything happens.
7. Use a graduated cylinder to measure 10mL of water.
8. Pour the water into a small container that was provided.
9. Carefully set the container inside the bag without spilling any of the water.
10. Zip the bag closed. Do not spill the container as you zip the bag closed.
11. Tip over the container inside the sealed bag.
12. Make careful observations.
13. Record your observations in your data table.

Data Collection:
Record you data in the following table.

	Observations before mixing substances		
Substance	Color	Solubility in water	State of Matter
Baking Soda		*Soluble*	
Road Salt		*Soluble*	
Observations after mixing substances but before adding water			
Observations after mixing substances and adding water			

Data Analysis:
When you mixed the baking soda, calcium chloride and water together what changes did you see that would indicate a chemical reaction occurred? Remember, when a chemical reaction occurs new properties are formed in the materials.

Conclusions:
Write a statement if a chemical reaction occurred or not.

- Individually, read through the sample lesson provided, and underline evidence of students using the dimensions of the NGSS
- Still working individually, reason about how the evidence fits together and connects to one or more of the criteria.
- Working in groups, share and discuss:
  - The evidence you found
  - The reasoning that explains the connections you've made between the evidence and rubric criteria

Be sure to respectfully challenge the thinking at your table (your own and your peers) by asking questions like:

- How does this piece of evidence specifically connect to the grade appropriate appendix element?
- In what ways does this evidence support students in developing and using this element?
- Are students developing this element in isolation, or is it connected to the other dimensions in a meaningful way?
- Is that piece of evidence explicitly in the lesson?
- If the evidence is not sufficient to connect to a rubric criteria, what could be changed about the lesson to improve this support?

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What did we find?

- What claims can you make about this lesson?
- What is your evidence and reasoning?
- Evaluate your peers' arguments- do you agree or disagree? What is your evidence and reasoning for your evaluation?
- What suggestions for improvement can you make to this lesson?

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Take-aways

- In what ways could the rubric and/or the process support classroom implementation of the NGSS?
- What can you do to help make this a reality?
- What challenges still exist? What kinds of resources would help you navigate these challenges?

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