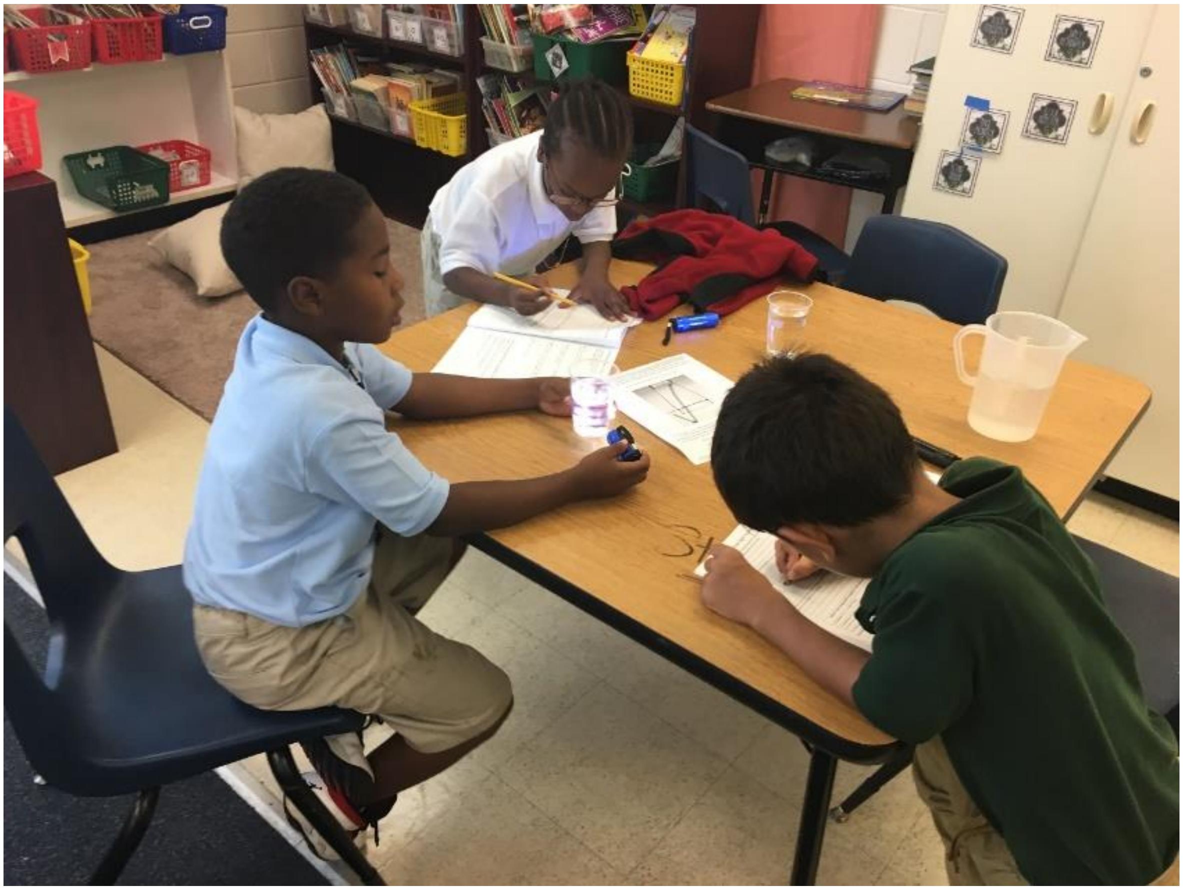
Why You Need a Model of Instruction to Activate Rigor in the Next Generation Science Standards



Pictured above: Students at Lakewood Elementary engage in collaborative learning as part of the Model of Instruction for Deeper Learning as they work on a science task about refracting light.

By: Dr. Jarri Goodman

Why It's So Difficult to Reach the Full Intent and Rigor of the Next Generation Science Standards

With a focus on real-world learning where students think like scientists and engineers, the K-12 Framework for Science Education and the Next Generation Science Standards (NGSS) represent a major shift in how student learn science.

From "Cookbook Labs" to Deeper Learning and Scientific Inquiry

The way we experienced science as K-12 students ourselves in the past – when we followed "cookbook recipe" lab sheets that outlined the steps to take in a science experiment – is no longer the norm. Students today are expected to come up with their own plan to carry out scientific investigations. They have the autonomy to try different approaches and get to the end goal of explaining scientific phenomena (observable events students can analyze or predict by applying their science knowledge).

NGSS curriculum guiding principles aim to create a more engaging inquiry-based learning environment with lessons designed around storylines driven by students' questions about how the world works. For example, an early elementary teacher might tell a story about seeing a puddle of water outside in the morning then noticing the water was gone by the afternoon. The teacher might ask students what questions they had and what they thought might have happened to the water.

The Overlooked Missing Piece: A Student-Led Model

What makes teaching to the rigor of the K-12 Framework for Science Education and NGSS standards so difficult is that traditional models of instruction – where teachers deliver lectures while students listen passively or teachers oversee group work as students compliantly follow steps and directions – do not lend themselves to the high levels of critical thinking and problem solving called for by the NGSS.

While attention is being brought to the need for more high-quality, aligned curriculum materials and content-focused professional development for teachers (Shaw & Hirsch, 2024), little has been shared about the need for a student-led model of instruction that allows for deeper learning of the science curriculum and opens access for all students to experience the intended rigor and richness of the Next Generation Science Standards.

How Your Model of Instruction Affects Students' Access to the Science Curriculum

No matter how high-quality the curriculum materials are, students can't experience the full power of those materials if their classroom uses a low rigor, low engagement, low agency model of instruction.

In the **traditional, teacher-directed model**, science instruction is often:

- **Low rigor** with surface level learning that emphasizes memorization and recall.

- **Low engagement** with a scripted science curriculum that relies heavily on lectures, worksheets, and independent practice.

- **Low agency** without a defined structure for releasing control to students to self-direct their learning and carry out scientific investigations.

Instructional Empowerment's **Model of Instruction for Deeper Learning** ™ provides the professional learning and resources for students and teachers that bring the Next Generation Science Standards to life through a student-led model.

Increasing Students' Access to the Three Dimensions of the Next Generation Science Standards

A particular challenge of the Next Generation Science Standards is that teachers often struggle with how to blend the three dimensions together.

1. **Crosscutting Concepts** guide how we look at the phenomena and help students explore connections across the domains of science to develop a coherent and scientifically-based view of the world around them.

2. **Science and Engineering Practices** guide the engagement students should experience as they investigate the world like scientists and design systems like engineers, building and applying their knowledge.

3. **Disciplinary Core Ideas** are the content of what the students are studying, grouped into four domains: Physical Science, Life Science, Earth and Space Science, and Engineering.

What I often see is teachers just teaching the content (Disciplinary Core Ideas), because it is so difficult to weave the Science and Engineering Practices and Crosscutting Concepts into traditional teacher-directed instruction. But it doesn't have to be this way.

Example: Science Task in Teacher-Directed vs. Student-Led Team Learning

Below, you will find an example of two tasks that tackle the same Next Generation Science Standard. Both utilize the same curriculum materials but result in totally different student learning experiences. **The difference is in the model of instruction.**

3rd Grade Next Generation Science Standard: 3-LS4-3 (Biological Evolution: Unity and Diversity). Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.

Traditional Task in a Teacher-Directed Model of Instruction:

1. The teacher provides a lecture about different habitats and their characteristics, highlighting specific animals that thrive, struggle, or cannot survive in each habitat.

2. Students complete a worksheet listing animals and categorizing them based on their likelihood of survival in various habitats provided by the teacher.
3. The teacher reviews the correct answers with the class, explaining why each categorization is accurate.

Student-Led Team Learning Task through the Model of Instruction for Deeper Learning:

1. Each team is provided with an anchor chart about habitats and a set of pictures and texts about animals. Each team member selects an animal to analyze.

2. Team members individually use the *Summarizing Thinking Guide* and *Summarizing Mat* to **analyze and interpret data** about their animal and explain why it is well-suited for the habitat, considering **cause and effect** and **structure and function**.

3. Team members use *Agree/Disagree Cards* to **engage in arguments from evidence** about how well their animals would survive. They are **obtaining, evaluating, and communicating information** from the text by sharing with their team and clarifying their thinking based on their peer discussion.

4. Together, the team synthesizes their findings on the *Summarizing Mat* to describe how the animals might survive well, barely, or not at all in the habitat described, including the factors that could contribute to those levels of survival.

Source for student-led team learning task: [Model of Instruction for Deeper Learning]™ 4DL Teacher Suite, Library 4DL Teacher Resources

Key Contrast:

- In the **teacher-directed task**, students passively receive information and work independently on a low rigor task with limited interaction. Students may learn the content of the Disciplinary Core Idea at a surface level, but likely do not experience the other two dimensions that the Next Generation Science Standards call for.

- In the **student-led team learning task**, students actively engage in analyzing, discussing, and constructing knowledge together. Not only are they learning the Disciplinary Core Idea, but they are also engaging in the Science and Engineering Practices and internalizing the Crosscutting Concepts.

"Dan is an 8th grade science teacher and is very passionate about his subject.

Two years ago, Dan would be doing experiments in front of students, hoping for 'ooohs' and 'ahhhs.' The students would be filling in a worksheet while watching him with goggles on and vapor oozing from a beaker.

One year ago, Dan would have the students do the same experiments but would have all of the materials laid out and the steps for the students to follow. They would be in "furniture groups" [students sitting together but not collaborating meaningfully] with the same worksheet.

But this year, Dan has laid the groundwork for experiments and the students are proving the theory behind the experiments and using whatever materials are in the classroom. They are learning from failure and they are learning from student-led team learning. Everyone on the team has a role and is bringing something to the table."

– Marian Grill*, School Leader, Edward Hand Middle School*

Originally submitted to AcademicTeaming.com

How Student Resources in the Model of Instruction for Deeper Learning Support the Next Generation Science Standards

One of the key points in the K-12 Framework for Science Education that struck me as important was that students should always have the opportunity to refine their ideas and knowledge. The thinking guides in the Model of Instruction for Deeper Learning are designed to help students do just that.

The thinking guides are all connected to the Science and Engineering Practices and help students internalize the Crosscutting Concepts and Disciplinary Core Ideas through deeper learning at higher levels of the taxonomy with analysis and knowledge utilization, rather than surface level memorization and recall that students often experience in a traditional model of instruction.

Resources	How They Support NGSS
Summarizing Thinking Guide: Helps students think individually, share their thinking in a team discussion with equal participation, and agree upon a team answer.	Students can use the organized structure of the Summarizing Thinking Guide to construct an explanation and engage in an argument using evidence. Their peers can evaluate the explanation, ask questions, and offer rebuttals. Students can strengthen their explanations and come to a team consensus.
Connecting New Learning Guide: Helps students draw on background knowledge, compare similarities and differences in their thinking with peers, and make connections between their new learning and the new learning of their teammates from the curriculum's texts, videos, or other sources.	Students can use the Connecting New Learning Guide to collaboratively analyze and interpret the information they obtain from the NGSS curriculum materials. They can engage in rigorous peer discourse where they are evaluating and communicating about what they learn. They benefit from hearing one another's perspectives and different ways of explaining something.

Expanding Thinking Guide: Helps students expand their own thinking by listening to the thinking of their peers, justify their answers by supporting with evidence, and reflect on different perspectives to refine their own thinking.	Students can use the Expanding Thinking Guide to share their questions and theories about a phenomenon with each other and push one another's thinking. They can decide how to plan and carry out investigations to test their theories. They can also receive peer feedback on models they have developed and compare models to determine how to best represent a phenomenon.
Resources available in the Model of Instruction for Deeper Learning ™ 4DL Teacher Suite	

How to Support Interdisciplinary Teaching and Learning Through the Model of Instruction for Deeper Learning

One concerning practice I have seen is districts removing science from the core curriculum in elementary school and making it a weekly exploratory elective class instead. The **Model of Instruction for Deeper Learning** can ensure science remains a priority by supporting the development of interdisciplinary tasks that integrate NGSS concepts into other core content areas.

For example, students can use the NGSS Science and Engineering Practices of engaging in an argument from evidence during English Language Arts. They can use their thinking guides from the Model of Instruction for Deeper Learning to present evidence during rigorous debates in their student-led teams. This type of interdisciplinary deeper learning would be difficult to achieve in a traditional model of instruction but comes naturally in a student-led model.

Make a Difference in Every Science Classroom, for Every Student

The deeper learning opportunities described above are possible for ALL students. We have partnered with schools and districts ranging from those tackling opportunity and achievement gaps to those who are high-performing and committed to continuous improvement, and we have found that every classroom benefits from a student-led model of instruction.

With the professional learning and resources of the **Model of Instruction for Deeper Learning**, teachers can activate the rigor in the Next Generation Science Standards and transform the student learning experience. Together, we can ensure **ALL students** experience a science education that is rich, rigorous, and engaging – empowering them to reach their full potential.

About the Author: Dr. Jarri Goodman

Jarri Goodman, EdD worked as a public school science and math educator at Title I schools in metro Atlanta. He was also a science instructional coach for a nonprofit science organization to support teachers, administrators, and district coordinators in developing their knowledge and instructional materials to support students in real-world scientific inquiry-based lessons aligned to the K-12 Framework for Science Education. Jarri believes that implementing quality inquiry-based instruction in science classrooms as early as kindergarten can impact students' later interest and success in STEM careers.

Jarri earned a dual bachelor's degree in early childhood/special education with a minor in general science from Mercer University. He received a master's degree in Curriculum and Instruction from Nova Southeastern University. Jarri obtained an Educational Specialist degree in Early Childhood Education with a concentration in Science Education from Mercer University. Jarri also holds a doctoral degree in Curriculum and Instruction from Liberty University.

As a consultant at Instructional Empowerment, Dr. Jarri Goodman supports schools in implementing evidence-based pedagogy to improve students' engagement in the learning experience.

References

Shaw, S. & Hirsch, E. (2024). The state of k-12 science curriculum. *State Education Standard, 24*(1). https://www.nasbe.org/the-state-of-k-12-science-curriculum/