Stanford NGSS Integrated Curriculum

Publisher Response

Stanford Center for Assessment, Learning, and Equity

The design of the *Stanford NGSS Integrated Curriculum* was driven by a very specific set of goals, models, and curriculum frameworks, some of which significantly depart from the criteria used by Ed Reports in their evaluation. First, the curriculum was developed to meet the goal of providing a complete set of grade 6-8 free, open source instructional materials. Second, it was designed to follow the California Preferred Integrated Model of the Next Generation Science Standards, in which disciplines are integrated within units rather than across a grade level course. Finally, the design was driven by the two research-based curriculum frameworks of the 5E instructional model and Project-Based Learning. Despite the discrepancies between the criteria Ed Reports uses and the design principles that underpin our curriculum, research[1] findings show substantial learning gains and teachers implementing the curriculum report inspiring stories of transformation in their science classrooms.

Open Source Instructional Materials

Many districts have not adapted new science materials since the 1990s because they cannot afford to. This has led to impoverished science programs in large portions of the country, further contributing to the inequity in access to quality science education in the United States. It is a primary goal of this curriculum to provide a complete set of free, adaptable instructional science materials for 6th-8th grade. We acknowledge that this curriculum has both its strengths and areas of growth. Because of its adaptable nature, teachers and district leaders are free to modify and adapt to strengthen the curriculum in a way that best fits the needs of their students.

California Preferred Integrated Model

We believe it is important to acknowledge that our curriculum is one of very few that integrates at least two disciplines within each unit, as opposed to alternating disciplines across the year. This is the preferred instructional model for the state of California, and it poses significant and unique design constraints (e.g., designing authentic projects that allow students to demonstrate performance expectations from multiple different disciplines). However, we think this approach better represents the interdisciplinary nature of phenomena that students will encounter in the world around them.

Research-based Frameworks

The two research-based curriculum frameworks that drove the design of these curricular materials--the 5E model and Project-Based Learning--are widely accepted by leading experts in the field. Yet, they lead to the design of materials that are in some ways incompatible with the specific criteria that EdReports uses for their evaluation.

These research-based frameworks led to intentional design decisions: 1) our curriculum was designed to cultivate students' proficiency with the three dimensions of the PEs over the course of the 5Es within each multi-lesson task; and 2) the phenomenon/design problem is incorporated at the unit-level and assessment of student sense-making using the three dimensions is assessed with the unit culminating project.

[1] Holthuis, N., Deutscher, R., Schultz, S. E., & Jamshidi, A. (2018). The New NGSS Classroom: A Curriculum Framework for Project-Based Science Learning. *American Educator*, *42*(2), 23-27. https://files.eric.ed.gov/fulltext/EJ1182064.pdf

5E Instructional Model: In the 5E model, students gradually develop proficiency with the 3 dimensions of a Performance Expectation over the course of a 5E learning sequence. According to Roger Bybee, lead author of the 5E model, different aspects of performance expectations should be foregrounded and backgrounded at different times during this sequence to acknowledge how students build proficiency in using multiple dimensions together over time.[2]

EdReports cites integration of all three dimensions across nearly all of the learning tasks, but notes missed opportunities for three-dimensionality in each learning opportunity within the learning tasks (ie. at the "E" level). We believe the scope at which multidimensionality is assessed in the report is misaligned with how our curriculum was designed. The curriculum was intentionally designed for students to build gradually toward proficiency with each PE (and its corresponding 3 dimensions) across the course of an entire learning task to prepare for assessment at the unit level, **not** within each "E" of a learning task. Within each "E" in the learning sequence, we made the pedagogical decision to foreground and background specific dimensions of the PE, as necessary, until students are ready to integrate all three dimensions. This takes into account how students build proficiency with multiple dimensions over time and is the pedagogical approach recommended by Roger Bybee. This also reflects the definition of the NGSS as "standards, not curriculum" or "goals, that reflect what a student should know and be able to do" by the end of a learning sequence (NGSS Executive Summary, pg. 2).

Project-Based Learning: The Ed Reports criteria takes one particular approach to the way phenomena should be embedded in instruction. Project-Based Learning takes a different approach, which research has demonstrated is an effective and valid approach to ground student learning in sensemaking about phenomena. In *Setting the standard for project based learning,* authors Larmer, Mergendoller, & Boss, describe the rationale underpinning the approach to presenting one problem or phenomenon-driven question at the beginning of a unit that drives students' work throughout a set of lessons. They state that focusing the entire unit on exploring a question or problem provides the organizing structure that gives the learning a purpose throughout the instructional sequence:

> "It is important that the inquiry be sustained. One of the goals of Gold Standard PBL is to build the success skills of critical thinking/problem solving, collaboration, and self-management. If this is to occur, then students need to confront problems and questions that are not resolved in a few class meetings. Difficult questions take more time to think through and solve."[3]

The report cites that within many of the learning tasks, students are not presented with a phenomenon or a problem. Instead, the phenomenon/problem is presented in the Lift-Off for each unit, and it motivates each of the subsequent tasks within the unit itself. As we described above, sustained exploration of a problem or phenomenon-driven question across a unit is fundamental to PBL. Thus, each task is not designed to have a separate phenomena/problem. Instead, the project context is designed to act as the phenomenon/problem; each task in a single unit contributes to students figuring something out about the question or problem; the tasks culminate with students making sense of the phenomenon/problem introduced at the beginning as part of the project. This is a common tension between NGSS and PBL, but we negotiate this tension by designing multi-lesson learning tasks that deepen three-dimensional learning which students will then use to make sense of a unit-level phenomenon/problem. In their 2019 article on project-based learning in science, Miller and Krajcik refer to these

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[2] Bybee, R. W. (2013). *Translating the NGSS for classroom instruction*. NSTA Press, National Science Teachers Association.
[3] Larmer, J., Mergendoller, J., & Boss, S. (2015). *Setting the standard for project based learning*. ASCD, 39-40.

as learning sets: "Each new learning set demands students deepen scientific understandings, referred to as *conceptual tools* (Blumenfeld et al., 1991), which they must use to make sense of the phenomenon (see Fig. 1) or solve the engineering problem (see Fig. 2)."[4] By assessing the use of phenomena/problems at the individual lesson level (rather than at the unit level), the EdReports evaluation was unable to account for the use of phenomena in a project-based curriculum.

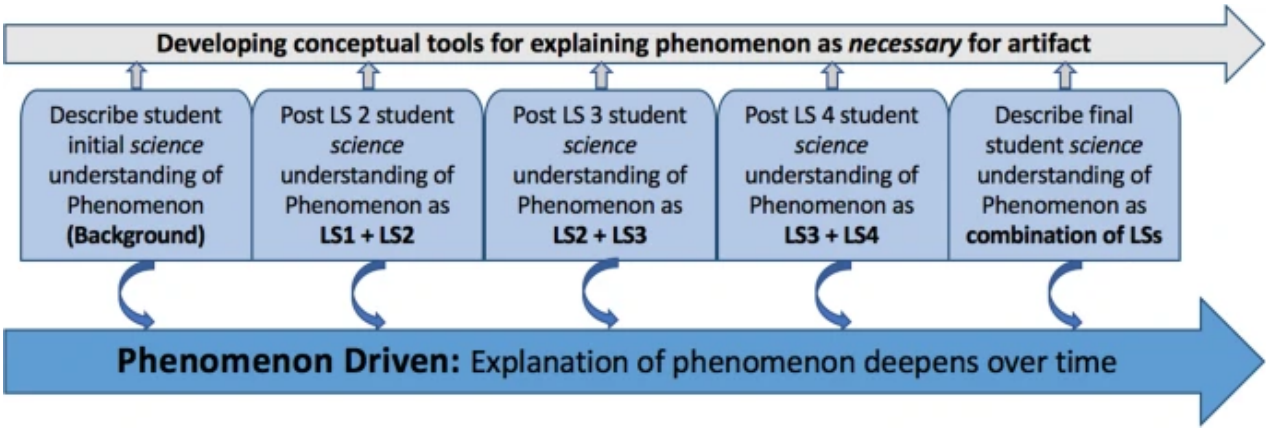

Figure 1 from Miller & Krajcik (2019)

The frameworks underpinning the decisions made in the design of this curriculum are not only backed by leading experts in the field, but also by research done by SCALE. It has been found to lead to significant learning gains and improved student engagement, particularly for English Learners. These learning gains extended even beyond science to impact student performance in math and ELA[1].

We acknowledge that the educator review team uses a very specific set of criteria in their evaluation of curriculum quality that uses a different set of principles than those that guided our design. For those looking for an Open Education Resource curriculum that is designed with a PBL, 5E, and Integrated approach, the Ed Reports criteria does not allow for a review that reflects an approach to curriculum design that will fit your needs. We hope that this explanation of our intentional design decisions helps you understand why we think this curriculum is a valuable resource for teaching the Next Generation Science Standards.

Please contact SCALE Science at scalescienceeducation@gmail.com if you have any further questions or if you need additional information.

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[4] Miller, E.C., Krajcik, J.S. Promoting deep learning through project-based learning: a design problem. *Discip Interdscip Sci Educ Res* 1, 7 (2019). https://doi.org/10.1186/s43031-019-0009-6