Stanford NGSS Integrated Curriculum

Background Information

Stanford Center for Assessment, Learning, and Equity

Overview

> *"First, I LOVE using your curriculum. Parents, my principal, my students, and I have ALL noticed student engagement and scientific learning go through the roof! Thank you!"* (*Teacher*)

The *Stanford NGSS Integrated Curriculum* was co-developed by the Stanford Center for Assessment, Learning, and Equity and middle school science teachers. This curriculum was designed using a framework that has been shown to support not only 3-D science learning, but it has also led to increased student engagement, language development, and learning in other content areas. These findings[1] are based on a study of SCALE's original 6th grade curriculum; The *Learning Through Performance* Curriculum. The striking outcomes of the research on the original 6th grade curriculum led SCALE to expand the use of this research-based curriculum framework to design a full 6th-8th grade program. Despite the discrepancy between the criteria Ed Reports uses and the design principles that underpin our curriculum, research findings show substantial learning gains and teachers implementing the curriculum report inspiring stories of transformation in their science classrooms.

A study[1] on the impacts of the LTP curriculum shows significant gains in 3-dimensional science learning based on an NGSS-designed pre-post assessment. In addition, there were increases in outcomes in math based on Smarter Balanced Assessment Consortium scores (14 points higher in Y2, and 20 points higher in Y3), English language arts (9 points higher in Y2, and 8 points higher in Y3), as well as increases in outcomes for English Language Learners on the California English Language Development Test (26 points higher in Y2, and 18 points higher in Y3).

The five principles underpinning the design of the *Stanford NGSS Integrated Curriculum* are: NGSS Design, Project-Based Learning, Performance Assessment, Groupwork, and Language Development.

NGSS Design

The curriculum materials support multidimensional science learning by providing instructional resources that make rigorous content accessible, and by engaging students in the application of knowledge and skills through authentic and meaningful projects that drive learning across a unit.

This curriculum follows the California Preferred Integrated Framework, meaning that multiple disciplines are integrated within an individual unit--each unit integrates two to three science content areas (life, physical, and earth), as well as engineering. This approach best represents the interdisciplinary nature of phenomena that students will encounter in the world around them. The curriculum addresses all of the Performance Expectations identified by NGSS for grades 6-8, with particular attention to the integration of all three dimensions in each Performance Expectation. Additional resources include a unit designed to support students in engaging productively and effectively in collaborative groups. Each unit also includes a *pop-out task*, which allows students

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[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

[2] Cohen, E. G. (2015). *Designing groupwork: Strategies for the heterogeneous classroom*. Hawker Brownlow Education.

to apply what they have learned across the unit to delve deeper into larger scientific considerations around diversity, equity, social justice, and the nature of science.

Each learning task within a unit (with the exception of the Lift-Off Task) follows the research-based 5E instructional model, engaging students in activities and experiences that support learning of the unit's disciplinary core ideas, crosscutting concepts, and science and engineering practices. The curriculum is designed around close adherence to grade-specific language in each dimension to ensure that it supports the "spiral" design of the NGSS, in which students continually build on knowledge and skills from prior grades and toward increasing levels of sophistication with the use and integration of the three dimensions.

Project-Based Learning

> *"I love the fact that the students are discovering the concepts rather than me just telling them. They are much more actively involved in their own learning."* (*Teacher*)

This curriculum follows a "project-based learning" framework, meaning students work in teams to tackle complex, real-world issues through rigorous, long-term projects. Each unit begins by introducing a phenomenon or problem that will become the basis for the unit culminating project. Each learning task within the unit provides opportunities for students to deepen their three-dimensional reasoning needed to make sense of the unit-level phenomenon/problem.

By centering the units around student sense-making and problem-solving of phenomena, the focus of learning shifts away from rote knowledge about science topics and toward students doing the "figuring out" about why or how things happen in the world. These open-ended projects are designed to be accessible to students at a wide range of proficiency by creating a variety of entry points and ways that students can both access the curriculum and show what they know and can do.

Performance Assessment

This design principle is closely tied to our previous design principle of Project-Based Learning, as the projects students engage with in each unit also serve as the summative performance assessments for each unit. These project-based performance assessments offer many benefits over traditional assessments:

1. They require students to demonstrate the kind of learning that 21st century society values--the ability to apply content and skills to make sense of real-world contexts in collaboration with their peers. This is also aligned with the NGSS vision of assessing practices and crosscutting concepts, not just science content.
2. Culminating projects are embedded in classroom instruction, blurring the lines between instruction and assessment and offering students opportunities to learn as they are assessed.
3. Projects encourage student choice and decision-making, which increases student engagement and accessibility.
4. The feedback teachers gain is rich and informative, allowing teachers to see what students *do* know and *can* do, rather than just what they don't know.

The curriculum materials also include multi-dimensional rubrics to guide teachers in assessing how students are progressing with integrating the disciplinary core ideas, crosscutting concepts, and science and engineering practices together.

Groupwork

> *"I value community and equity in my classroom, and SCALE has interwoven these into the content so they do not appear to be stand alone topics."* (*Teacher*)

The curriculum includes many different student participation structures, but the use of small groups is central to its design. Groupwork has been found to promote academic goals, such as deeper conceptual learning, language development, and scientific practices. In addition, when implemented well, it has the capacity to promote more equitable classrooms by addressing issues of "status" among students and ensuring all students can access and participate within the curriculum[2]. However, groupwork can be challenging to implement successfully. The curriculum materials offer extensive support strategies[2] to target the common challenges seen when students work together in small groups. This includes the preparatory groupwork unit at the beginning of every grade level as well as integrated supports, such as group roles and building/reinforcing community norms.

Language Development

> *"I really cannot say enough good things about your curriculum. It has changed my students' learning so dramatically, that my principal simply cannot get over the level of science learning and vocabulary used by my students!* (*Teacher*)

It is well researched that language development is a key component for both developing and communicating understanding within a discipline and helps to support more rigorous and equitable outcomes for diverse students[3]. When students are equipped and supported in using language for scientific sense-making, they develop both a greater understanding of the science concepts, as well as a way to communicate their understanding.[4] Every learning task in this curriculum includes opportunities for students to speak, listen, read, and write--creating a language-rich environment for students to develop both their language and scientific understanding. To help students meet the language demands of each curriculum task, language supports and routines are embedded throughout, ensuring that all students, and particularly English Learners, are well-supported.

Accessibility

> *"[The Stanford NGSS Integrated Curriculum] is also the only open source I have found that meets all the criteria for NGSS, and is easy to implement."* (*Teacher*)

One of the primary goals of this curriculum is to provide all teachers access to a quality comprehensive science curriculum that is not constrained by funding. By providing a complete set of free, adaptable instructional science materials for 6th-8th grade, teachers and district leaders have the flexibility to modify and adapt the curriculum in a way that best fits the needs of their students. The teacher guides that are included provide a wide array of

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[2] Cohen, E. G. (2015). *Designing groupwork: Strategies for the heterogeneous classroom*. Hawker Brownlow Education.

[3] Hakuta, Kenji, et al. "Challenges and Opportunities for Language Learning in the Context of the CCSS and the NGSS." *Journal of Adolescent & Adult Literacy*, vol. 56, no. 6, 2013, pp. 451–454., doi:10.1002/jaal.164.

[4] Lee, O., Quinn, H., & Valdes, G. (2012). Language Demands and Opportunities in Relation to Next Generation Science Standards for English Language Learners: What Teachers Need to Know. *Understanding Language: Stanford University School of Education*.

instructional supports that teachers can use to meet their various contexts. The curriculum is also designed for accessibility by utilizing as many affordable household materials as possible.

Supplemental Services

> *"[The Stanford NGSS Integrated Curriculum] has definitely provided a shift in the way I approach science and teaching as a whole."* (*Teacher*)

Teachers and districts participating in Professional Development services have shared that science educators are experiencing a "shift" in their understanding of effective and equitable instruction as a result of using this curriculum. Using this curriculum provides teachers with a "critical lens" through which they can examine their own classroom practices. In doing so, the *Stanford NGSS Integrated Curriculum* acts as a tool to help teachers construct their own vision of an NGSS classroom.

The *Stanford NGSS Integrated Curriculum* is free and available for download on the SCALE Science Website. If you are interested in Professional Development or coaching services to support implementation of the *Stanford NGSS Integrated Curriculum,* please contact scalescienceeducation@gmail.com.