Promoting Science Among English Language Learners (P-SELL) Scale-Up (NSF 1209309)

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Development of Language-Focused Three-Dimensional Science Instructional Materials to Support English Language Learners in Fifth Grade

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Student Diversity

- **Poverty:** “ Majority of U.S. public school students are in poverty” (51%), *New York Times*, January 16, 2015
- **Race and ethnicity:** “U.S. school enrollment hits majority-minority milestone” (this fall), *Education Week*, February 1, 2015
- **Disabilities:** 12% of students received special education services in 2011
- **English language:**
  - 21% of students speak a language other than English at home in 2011
  - 9% of students participate in ELL programs in 2011

Teaching STEM for diversity is teaching STEM for all.
3-Dimensional Learning

- To explain phenomena (science) and design solutions to problems (engineering)
- To occur in local contexts (e.g., homes and communities) that capitalize on students’ everyday language and experience
Framework and NGSS for English Language Learners (ELLs)

• Raise the bar for content (academically rigorous)

• Raise the bar for language (language intensive)

• Call for a high level of classroom discourse for all students, including ELLs
Asking questions and defining problems

Developing and Using Models

Planning and carrying out investigations

Obtaining, evaluating, and communicating information

Engaging in argument from evidence

Construction explanations and designing solutions

Analyzing and interpreting data

Using mathematics and computational thinking

Next Generation Science Standards
For States, By States
ELLs: Old Paradigm

Content

Vocabulary
Grammar
Native-like fluency

Language

Source: Linquanti & Hakuta, 2012; ell.stanford.edu
ELLs: New Paradigm

[Diagram showing the overlap of Content and Language with detailed elements like Discourse Modeling, Explanation, Argumentation, Text (complex text), Text structure, Sentence structure, Vocabulary, Grammar.]

Source: Linquanti & Hakuta, 2012; ell.stanford.edu
## Conceptual Framework: Language Use in the Science Classroom

### NGSS Practice 7: Engage in argument from evidence

<table>
<thead>
<tr>
<th>Analytical Science Tasks</th>
<th>Receptive Language Functions</th>
<th>Productive Language Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Distinguish between a claim and supporting evidence or explanation</td>
<td>• Comprehend arguments made by others orally</td>
<td>Communicates (orally and in writing) ideas, concepts, and information related to the formation, defense, and critique of arguments</td>
</tr>
<tr>
<td>• Analyze whether evidence supports or contradicts a claim</td>
<td>• Comprehend arguments made by others in writing</td>
<td>• Structure and order written or verbal arguments for a position</td>
</tr>
<tr>
<td>• Analyze how well a model and evidence are aligned</td>
<td>• Construct an argument</td>
<td>• Select and present key evidence to support or refute claims</td>
</tr>
<tr>
<td>• Construct an argument</td>
<td></td>
<td>• Question or critique arguments of others</td>
</tr>
</tbody>
</table>
Design Principles for Instructional Materials

Science

- Select a phenomenon or problem in a **community-based context**, specifically students’ home and community experience to build on prior knowledge and generate language including home language
- Engage in **three-dimensional learning**
- Build **coherence** (i.e., learning progressions) over time

Language

- Promote language use
- Support for ELLs at different levels of English proficiency

Assessment

- Assess 3-D science learning
- Assess language use
Unit 1: What Happens to Our Garbage?

5-PS1-1: Develop a model to describe that matter is made of particles too small to be seen

5-PS1-2: Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved

5-PS1-3: Make observations and measurements to identify materials based on their properties

5-PS1-4: Conduct an investigation to determine whether the mixing of two or more substances results in new substances

5-LS2-1: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment

5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment

3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost
Research and Development Plan

Research Sites
• One school district in California
• One school district in New Jersey

Development
Year 1 (2015-2016): Development of instructional materials with students and teachers, with limited field testing

Year 2 (2016-2017): Continued development and field testing of instructional materials

Year 3 (2017-2018): Field testing of instructional materials

Year 4 (2017-2018): Pilot study to investigate the impact of the intervention on teachers and students
Thank You!

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