Expanding “Good Start” Science Activities: How to Get More Out of Typical Preschool Science Experiences

Alissa A. Lange, Ph.D.
Kimberly Brenneman, Ph.D.
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Overview

• Rationale for SciMath-DLL project
• Typical science experiences
  – What are they?
  – Why do more?
• Let’s try it!
• Recap and future directions
RATIONALE
Early Science

• Early science and social studies knowledge is critical for later science, math, and reading (Grissmer et al., 2010)

• Among Head Start readiness domains, science was the lowest and grew the least over the preschool year (Greenfield et al., 2009).

• Science achievement gaps start early, persist, and are largely explained by malleable factors (Morgan et al., 2016)
Science, Language, & Literacy

• Science learning experiences increase receptive vocabulary (French, 2004).
• They provide opportunities to learn the rich vocabulary that links to better reading skills.
• Knowledge of the world is essential for constructing meaning from text (Duke & Carlisle, 2011)
• Science learning experiences increase grammatical complexity of children’s language (Petersen & French, 2008).
Challenges

• High-quality math and science teaching is not common (Ginsburg et al., 2008; Nayfeld et al., 2011; Tu, 2006)
• Preschool teachers are not typically well-prepared to teach STEM (NRC, 2009) or DLLs (Espinosa, 2010; Freedson, 2010)
• Educators do not typically feel confident in their abilities

Example of an exploration/science table in a preschool classroom being used to dry art projects

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SciMath-DLL is a professional development model that aims to improve the quality of early science, technology, engineering, and mathematics (STEM) teaching and learning for all children, including dual language learners (DLLs) (www.scimathdll.com)
PD Model

• Workshops

• Individualized Reflective Coaching Cycles (RCCs)

• Professional Learning Communities (PLCs)

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Theory of change

**Inputs**
- Workshops
- RCCs
- PLCs

**Immediate/Intermediate Impacts**
- Improved teaching and coaching quality; changed attitudes & beliefs; improved STEM & DLLs teaching strategies; increased content knowledge and PCK

**Long-Term Impacts**
- Improved outcomes for children

**Features**
- Dosage
- Context
- Motivation

**How Measured**
- Classroom quality observations
- Qualitative data
- Assessment scores
- Science, math, language child assessments
Activity that Exemplifies Our Approach to STEM
SciMath-DLL Approach To Teaching Early STEM*

<table>
<thead>
<tr>
<th>Provide learning experiences that:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Are open to deep exploration over time</td>
</tr>
<tr>
<td>• Have identifiable, achievable, and assessable learning objective(s)</td>
</tr>
<tr>
<td>• Have an appropriate amount of content/no 'overstuffing'</td>
</tr>
<tr>
<td>• Involve 'Thinking outside the kit'</td>
</tr>
<tr>
<td>• Include rich &amp; appropriate language: for DLLs &amp; all learners</td>
</tr>
</tbody>
</table>

*A selection of approach components*
## Adapt Questioning

<table>
<thead>
<tr>
<th>Language Level</th>
<th>Example Questions</th>
<th>Types of Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Home Use/Non-Verbal</strong></td>
<td>Show me...</td>
<td>- Known answer</td>
</tr>
<tr>
<td></td>
<td>Point to...</td>
<td>- Closed</td>
</tr>
<tr>
<td></td>
<td>Where is?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Who has?</td>
<td></td>
</tr>
<tr>
<td><strong>Telegraphic/Formal</strong></td>
<td>Yes/No questions</td>
<td>- Known answer</td>
</tr>
<tr>
<td></td>
<td>Either/Or questions</td>
<td>- Closed</td>
</tr>
<tr>
<td><strong>Productive</strong></td>
<td>Why?</td>
<td>- Thought-provoking</td>
</tr>
<tr>
<td></td>
<td>How?</td>
<td>- Open-ended</td>
</tr>
<tr>
<td></td>
<td>Explain</td>
<td></td>
</tr>
<tr>
<td><strong>More Advanced Productive</strong></td>
<td>What would happen if?</td>
<td>- Thought-provoking</td>
</tr>
<tr>
<td></td>
<td>Why do you think?</td>
<td>- Open-ended</td>
</tr>
<tr>
<td></td>
<td>Retell...</td>
<td>- Prediction</td>
</tr>
</tbody>
</table>

_Sources_: Krashen & Terrell (1983); Tabors (2008)
TYPICAL SCIENCE EXPERIENCES
What Are Some Examples?

- Earth and space science: **Weather**
- Earth and space science: **Light and shadows**
- Life science: **Planting and growing; Butterflies**
- Life science: **The 5 Senses**
- Life science: **Animals and habitats**
- Physical science: **Properties of matter - sink and float**
- Physical science: **Properties of matter - change and transformation**
Why Do More?

• Extended, connected learning experiences support deeper understanding

• Children are capable of this!

• Builds stronger conceptual foundations for school science learning

• Children deserve this!

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At your tables

LET’S TRY IT!
Example Activity 1: 
*Making Play Dough*

- What are your learning objectives?
- How do you typically start?
- Another way to start
Example Activity 1: *Making Play Dough (cont.)*

- See small group learning experience (SGLE) annotated lesson plan
- Explore ingredients
  - Pour out a little of each
  - Ask children for their observations
  - Record observations

- Then, stop there...no play dough yet!
Example Activity 1: 
Making Play Dough (cont.)

• What’s next?

• Try it at your tables (see SGLE)

• Discuss
Example Activity 2: *Sink and Float*

- What does this typically look like?
Example Activity 2: *Sink and Float (cont.)*

- “Heavy things sink, light things float”
• But is this true?
Example Activity 2:  
*Sink and Float (cont.*)

- If it is not always true that heavy things sink and light things float...
- What is true about sink and float?
  - Density
  - Buoyancy
  - Surface tension
3 Blocks with Same Volume

- **Solid block of wood**: 50 pounds
- **Hollow box**: 10 pounds
- **Foam**: one pound
Density with Children?

- What can we do with sink and float that is accurate and age appropriate?
Example Activity 2: 
*Sink and Float (cont.)*

• Another way to start...play around first
Example Activity 2: 
*Sink and Float (cont.*)

• What’s next?

• Two focused learning experiences
  – Material Matters
  – Shape Matters

• Notice that these experiences
  – Focus on one attribute at a time. Why?
  – Encourage rich scientific *practices* that young children can engage in while doing these.
Material Matters Video
Example Activity 2: 
*Sink and Float (cont.)*

• Try it at your tables

• Discuss
RECAP AND FUTURE DIRECTIONS
To Recap

- Teachers can enhance typical “good start” preschool science activities by
  - Extending learning over time
  - Focusing on achievable learning objectives
  - Simplifying activities
  - Choosing materials intentionally
  - Using (and eliciting) rich language
Our Approach: Results

• Increased teacher use of math and science vocabulary
• Improved student vocabulary and language skills (noted by many)
• Greater use of science and math vocabulary and in English language by DLLs

Data Sources: Teacher and coach report, Observational notes, External evaluator survey
Our Approach: Results (cont.)

- “[The teacher] asked children to explain themselves more this time around than the last couple times I've seen her” - Master Teacher, end of first year of participation
- “The dual language learners' thinking and counting skills improved greatly. The students were more confident with doing simple activities rather than complex ones.” (Teacher, External evaluator, Year 3).
- “Students are answering in their home language and or better English language. Students are making connections with whole sentences made.” - Teacher, end of first year of participation
Our Approach: Results (cont.)

“At report card night I shared with a parent that her child’s science skills have shown progress... Mom’s response was “I know!” Then the student shared “I love science!” THIS KIND OF INTERACTION HASN’T HAPPENED IN MY 10+ YEARS OF TEACHING PRE-K. I felt like I wouldn’t have mentioned this before I started participating in this study. I’m slowly overcoming that fear of not knowing all the answers when it comes to science and sometimes math, and I have this study to thank for it.”

- Teacher comment, external evaluator survey, Spring 2016
Future Directions

• Our current project is
  – Piloting online versions, like online coaching

• Dissemination

• Family Engagement
Thank You!

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Contact Information

• For more information or for copies of learning activity plans, please email Dr. Lange.

• People
  – Alissa Lange
    alange@nieer.org / scimathdll@gmail.com
  – Kimberly Brenneman
    kbrenneman2@gmail.com

• Websites
  – www.scimathdll.org
  – www.nieer.org