Teaching Science with Confidence In Pre-K And Early Elementary:

Opportunities And Challenges

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GOALS for Today

To discuss early childhood (EC) science in relation to these questions:

• What is the vision of the Next Generation Science Standards (NGSS)?
• What does good EC science look like/sound like?
• What do adults need to know and be able to do in order to teach science well?
• How can we address the challenges faced by the field in enacting the vision of the NGSS?
Stream of Early Science Work

Guides: Water, Nature, Structures
NSF: 2002-2005

PD Development: Physical Science
IES: 2005-2009

Efficacy Trial: Physical Science
IES: 2009-2013

PD Development: Nature, Structures
IES: 2012-2016

PD Literacy through Science
I3: 2014-present

• Young Scientist Series (YSS)
• Foundations of Science Literacy (FSL)
• Cultivating Young Scientists (CYS)
• Literacy and Academic Development for English Learners through Science
Everyone agrees we need to do a better job of teaching science in early childhood (3-8).
Misconceptions in science develop early, and if not addressed, can persist into adulthood.
Extending into middle school for example, many children have little to no understanding of the characteristics and needs of plants, that plants are living things, that trees are plants, or that not all plants have flowers.

And many children, particularly girls and children of color, lose interest in science and/or begin to view themselves as incapable of science learning and thinking.
<table>
<thead>
<tr>
<th>Subject</th>
<th>Grades K–3 and Minutes</th>
<th>Grades 4–6 and Minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading/Language Arts</td>
<td>89</td>
<td>83</td>
</tr>
<tr>
<td>Mathematics</td>
<td>54</td>
<td>61</td>
</tr>
<tr>
<td>Science</td>
<td>19</td>
<td>24</td>
</tr>
<tr>
<td>Social Studies</td>
<td>16</td>
<td>21</td>
</tr>
</tbody>
</table>

2012 National Survey of Science and Mathematics Education conducted by Horizon Research, Inc., Chapel Hill, NC
Table 2.28 Elementary Teachers’ Perceptions of Their Preparedness to Teach Each Subject

<table>
<thead>
<tr>
<th>Subject</th>
<th>Not Adequately Prepared</th>
<th>Somewhat Prepared</th>
<th>Fairly Well Prepared</th>
<th>Very Well Prepared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading/Language Arts</td>
<td>0</td>
<td>2</td>
<td>17</td>
<td>81</td>
</tr>
<tr>
<td>Mathematics</td>
<td>1</td>
<td>3</td>
<td>19</td>
<td>77</td>
</tr>
<tr>
<td>Social Studies</td>
<td>1</td>
<td>12</td>
<td>41</td>
<td>47</td>
</tr>
<tr>
<td>Science</td>
<td>2</td>
<td>15</td>
<td>43</td>
<td>39</td>
</tr>
</tbody>
</table>

2012 National Survey of Science and Mathematics Education conducted by Horizon Research, Inc., Chapel Hill, NC
## Table 3.3 Time Spent on Professional Development in the Last Three Years, by Subject and Grade Range

<table>
<thead>
<tr>
<th>Subject</th>
<th>Elementary</th>
<th>Middle</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Science</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 6 hours</td>
<td>65</td>
<td>30</td>
<td>23</td>
</tr>
<tr>
<td>6-15 hours</td>
<td>22</td>
<td>24</td>
<td>20</td>
</tr>
<tr>
<td>16-35 hours</td>
<td>8</td>
<td>20</td>
<td>21</td>
</tr>
<tr>
<td>More than 35 hours</td>
<td>4</td>
<td>27</td>
<td>26</td>
</tr>
<tr>
<td><strong>Mathematics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 6 hours</td>
<td>35</td>
<td>22</td>
<td>23</td>
</tr>
<tr>
<td>6-15 hours</td>
<td>35</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>16-35 hours</td>
<td>20</td>
<td>23</td>
<td>22</td>
</tr>
<tr>
<td>More than 35 hours</td>
<td>11</td>
<td>31</td>
<td>32</td>
</tr>
</tbody>
</table>

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There is some agreement on what good early childhood science looks like.
NSTA Position Statement: Early Childhood Science Education

- Adopted by NSTA in 2014
- Endorsed by NAEYC
- Incorporates principles to guide science teaching and learning and recommendations for teacher education

http://www.nsta.org/about/positions/earlychildhood.aspx
The Next Generation Science Standards (NGSS): A vision for 21st century science education

1. Focus on core ideas, cross-cutting concepts, and science and engineering practices

2. Emphasize critical thinking and problem-solving

3. Take a learning progressions approach
What does this vision look like when enacted in real classrooms?
Creating a system for moving water and asking questions about how water and bubbles look and behave.
Investigating balance and design and recording data about structures
Creating shadows to investigate characteristics of light and how it interacts with various objects

Photo credit: Peggy Ashbrook

Photo credit: Anne Marie Whang
Identifying, addressing, and solving engineering challenges with balls and ramps
Analyzing data about living things and making claims about their characteristics, and needs.
Constructing explanations about shadows

Children’s initial ideas about how and why shadows are moving:

“My shadow is going in circles because I’m moving my hand.”

“The shadow is moving up and down because the flashlight is moving it.”

“The shadows are going on the ground and all around because of the light.”

“My shadow was wiggling because I was wiggling the flashlight.”
What are teachers doing in these classrooms?
As you view the video consider:
• How is Kaitlyn interacting with children?
• What makes this effective teaching?

Investigating earthworms and mealworms
“The three most important aspects of a teacher’s role in primary science...[are] providing materials for children to observe and investigate, asking the right kinds of questions, and helping children to discuss or, more widely, to communicate their thinking and developing ideas”

Turn and talk

What is the difference between these two questions:

A. What is this part of the plant called?

B. How do you think this part of the plant helps the plant?
What is the difference between these two questions:

A. Why does this object float?

B. Why do you think this object floats?
As you view the video, consider:
• How do Jenna’s questions promote Elijah’s thinking?
• How does drawing support the conversation?

Elijah draws to learn
What does a teacher need to know and be able to do in order to have these types of interactions with children?
What does a teacher need to know and be able to do in order to have these types of interactions with children?

**Pedagogical Content Knowledge (PCK) in Science**

- Science Content Knowledge
- Child Development Knowledge
- Knowledge of Pedagogy
Pedagogical Content Knowledge (PCK)

“...the intersection of content and pedagogy,... the capacity of a teacher to transform the content knowledge he or she possesses into forms that are pedagogically powerful and yet adaptive to the variations in ability and background presented by the students.”

Lee Shulman
There is some agreement about the experiences that build teacher PCK in science.
Effective professional development builds teachers’ PCK by (among other things):

1. Immersing them in “hands-on, mind-on” inquiry
2. Modeling good science teaching
3. Providing opportunities for reflection
4. Incorporating coaching support
THE ELEPHANT IN THE ROOM
Why haven’t we been able to do what’s best for children and teachers?
The Challenges

- Students are not doing enough science in school.
- Teachers are not (and do not feel) prepared to teach science.
- Teachers do not receive adequate professional development (and/or the other supports they need) to teach science well.
How might your group begin to think about and address one of these challenges?
THANK YOU

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