Science, Technology, and Engineering and Young Children: A Focus on Professional Development

STEM Start Conference

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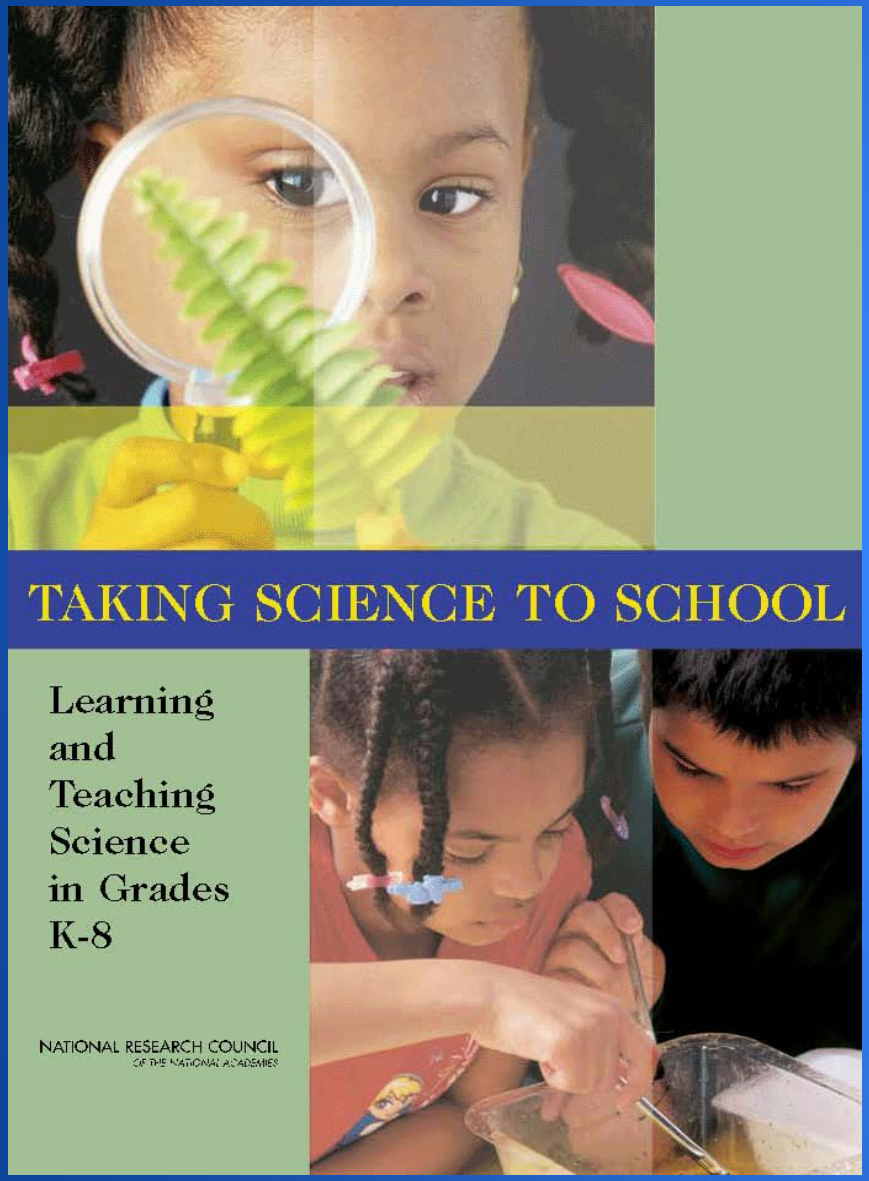
Questions

- What evidence do you of children's learning?
  - Content
  - Practices
- What instructional strategies is the teacher using to encourage thinking?
- How does the physical environment support learning?
- What are some implications for professional development?



"… research shows that children's thinking is surprisingly sophisticated…. Children can use a wide range of reasoning processes that form the underpinnings of scientific thinking, even though their experience is variable and they have much more to learn."

Taking Science to School
Executive Summary
National Research Council. 2007.
Duschl, RA, & Shouse, AW., eds.
Washington, Dc: National Academy Press

Conclusion: Children starting school are surprisingly competent

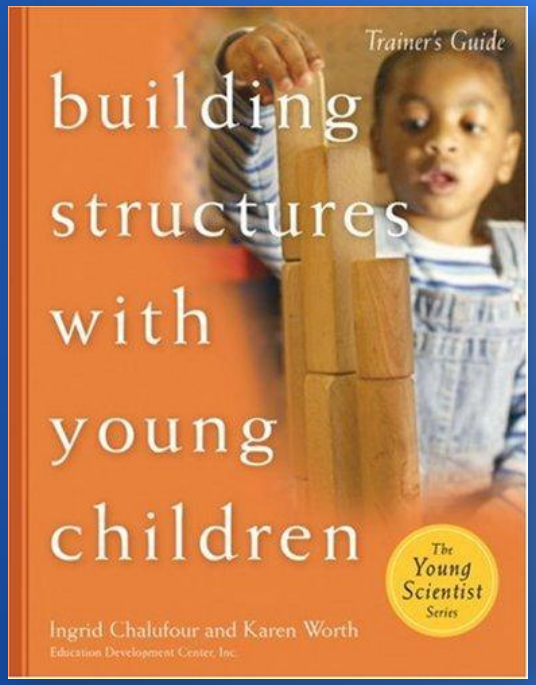
- Children entering school already have substantial knowledge of the natural world much of it implicit.
- Young children are NOT concrete and simplistic thinkers, they think abstractly long before coming to school.
- Children can use a wide range of reasoning processes that form the underpinnings of scientific thinking

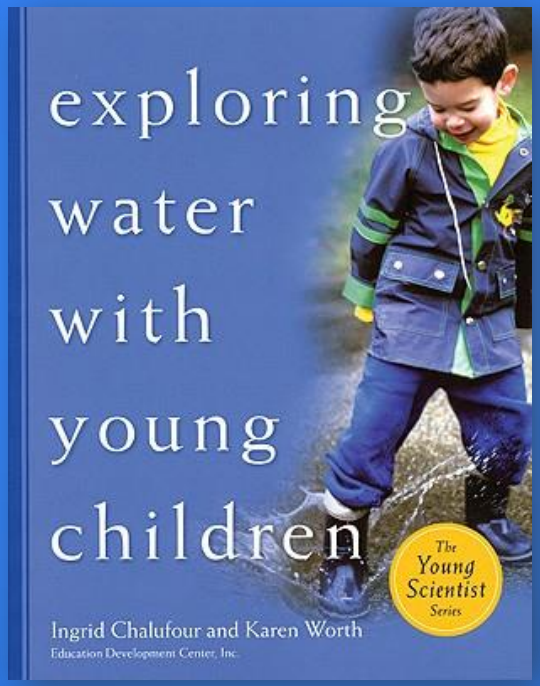
Taking Science to School, K-8
National Research Council. 2007.
Duschl,RA, & Shouse, AW., eds.
Washington, Dc: National Academy Press

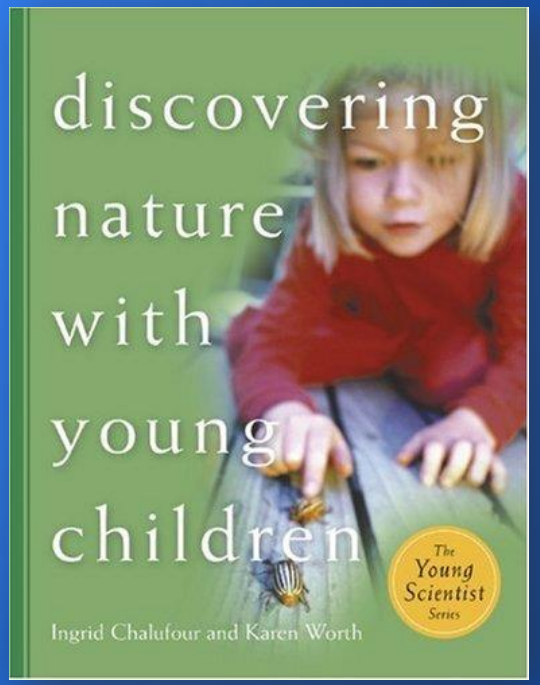
Resources from Red Leaf Press

Young Scientist Series

Ingrid Chalufour & Karen Worth





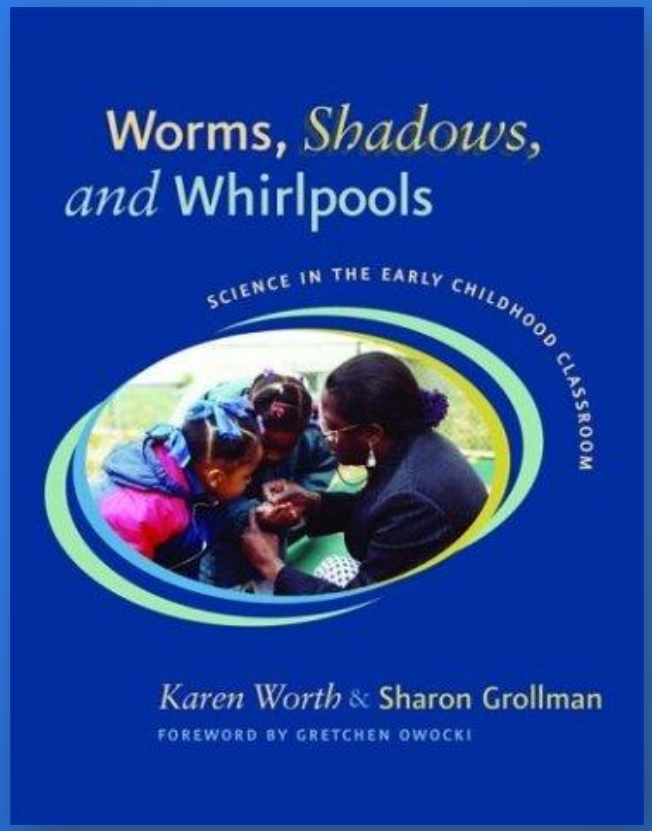


Education Development Center, Inc.

Resource from Heinemann

Worms, Shadows, and Whirlpools

Karen Worth and Sharon Grollman



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What Teachers Do in Effective Science Classrooms

- Choose a focus for inquiry
- Prepare themselves to teach the topic
- Create a physical environment that supports inquiry
- Plan a schedule that allows time for inquiry
- **Encourage children's work and deepen their understanding**
- **Observe and assess individual children and the group**

Deepening Children's Understanding

- Engage children in conversation as they work
- Foster children's questioning
- Challenge children to go deeper
- Facilitate group discussions before during and after investigations
- Guide reflection
- Encourage children to document and represent their work
- Document what is happening

Assessing Children's Understanding

- Observe and document children's behaviors
- Collect and document children's work
- Question and probe children's thinking individually and in groups
- Design embedded assessments

Progression of Work

Guides:
Water, Nature, Structures
NSF
2000-2005

Book:
Worms, Shadows and Whirlpools
NSF
2000-2005

Assessment:
Science Teaching and Environment Rating Scale (STERS)
IES
2005-6

PD Development :
Physical Science

IES
2005-2009

Efficacy Trial:
Physical Science

IES
2009-2013

PD Development:
Nature, Structures

IES
2013-present

Professional Development

- How much science would be helpful for teachers?
- What's the value of a full course?
- What is the optimal ratio of content to pedagogy?
- What ought to be the role of in-class support?
- What are indicators of success for teachers? Children?

Water

- Comprehensive professional development program using the Exploring Water guide and Worms, Shadows & Whirlpools
- Supports application to classroom practices through
  - 42 hours of instruction (credit-bearing)
  - Group & individual mentoring
  - Classroom-based assignments

Deepening teachers' understanding of and ability to teach early childhood science by

- Engaging teachers in their own "minds-on" science explorations to build conceptual understanding and inquiry skills.
- Making the transfer to children's learning through direct instruction, small-group discussion, and video analysis.

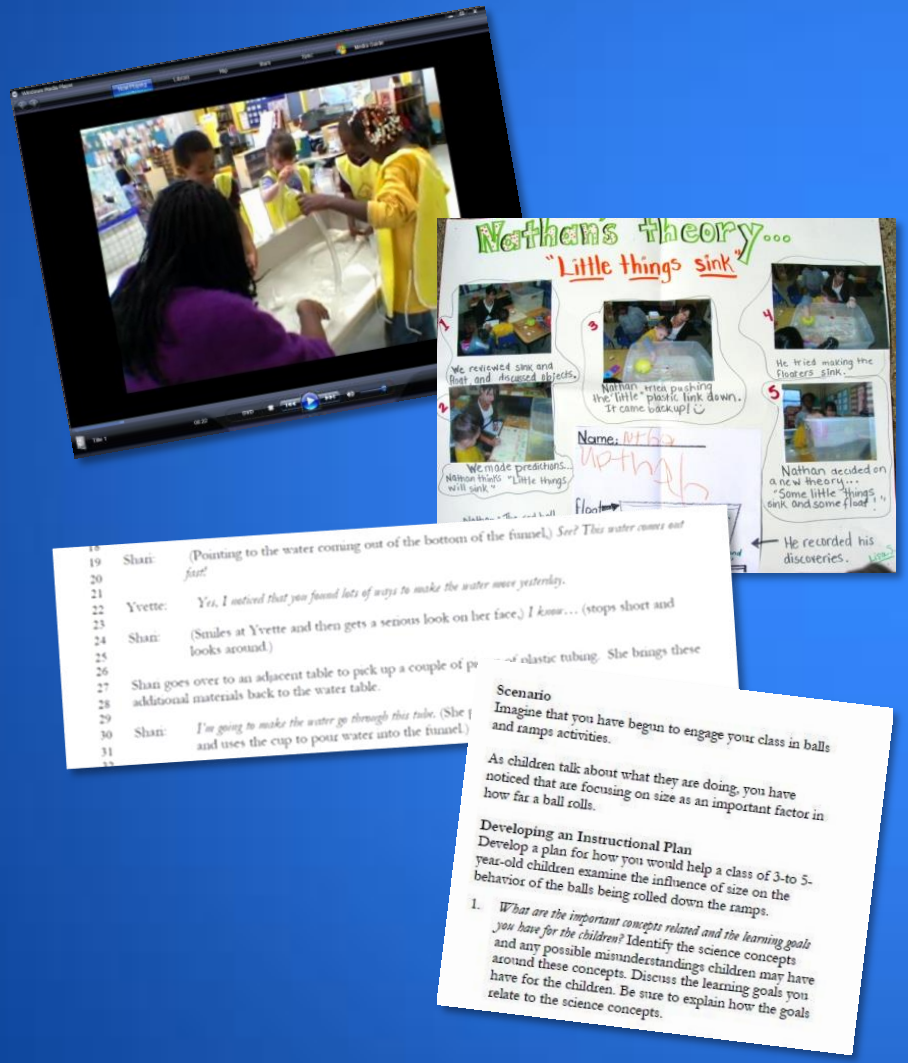
Deepening teachers' understanding of and ability to teach early childhood science by

- Introducing three supportive frameworks for teachers to use as they plan and implement explorations in their own classrooms.
- Providing opportunities to engage in collaborative analysis of evidence of their children's learning.

Science Teaching and Environment Rating Scale (STERS)

Item #	*STERS* Component of Science Teaching
1	Create a physical environment for science inquiry and learning
2	Facilitate direct experiences to promote conceptual learning in science
3	Promote the use of scientific inquiry
4	Create a collaborative climate that promotes exploration and understanding
5	Opportunity for extended science conversations
6	Build children's science-related vocabulary
7	Plan in-depth investigations on science topics
8	Assess children's science learning

Science Teacher Performance Tasks (STPTs) to assess teacher pedagogical content knowledge

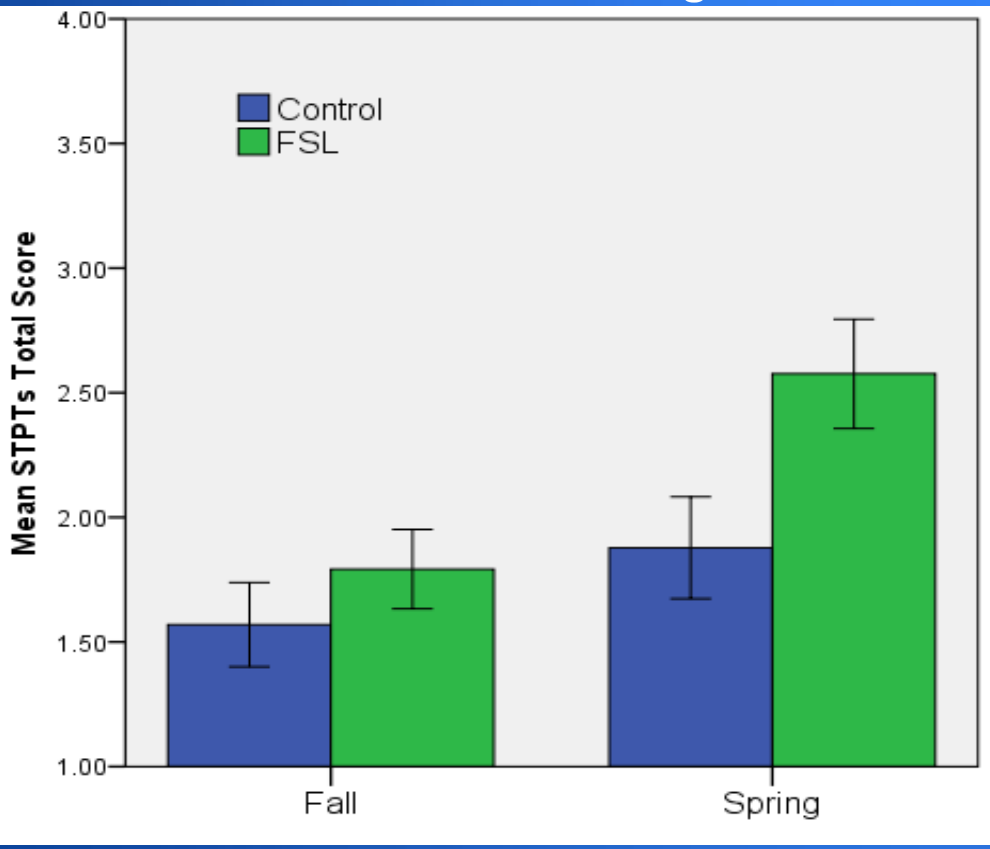


Teachers complete four written items, scored on 4-point scale

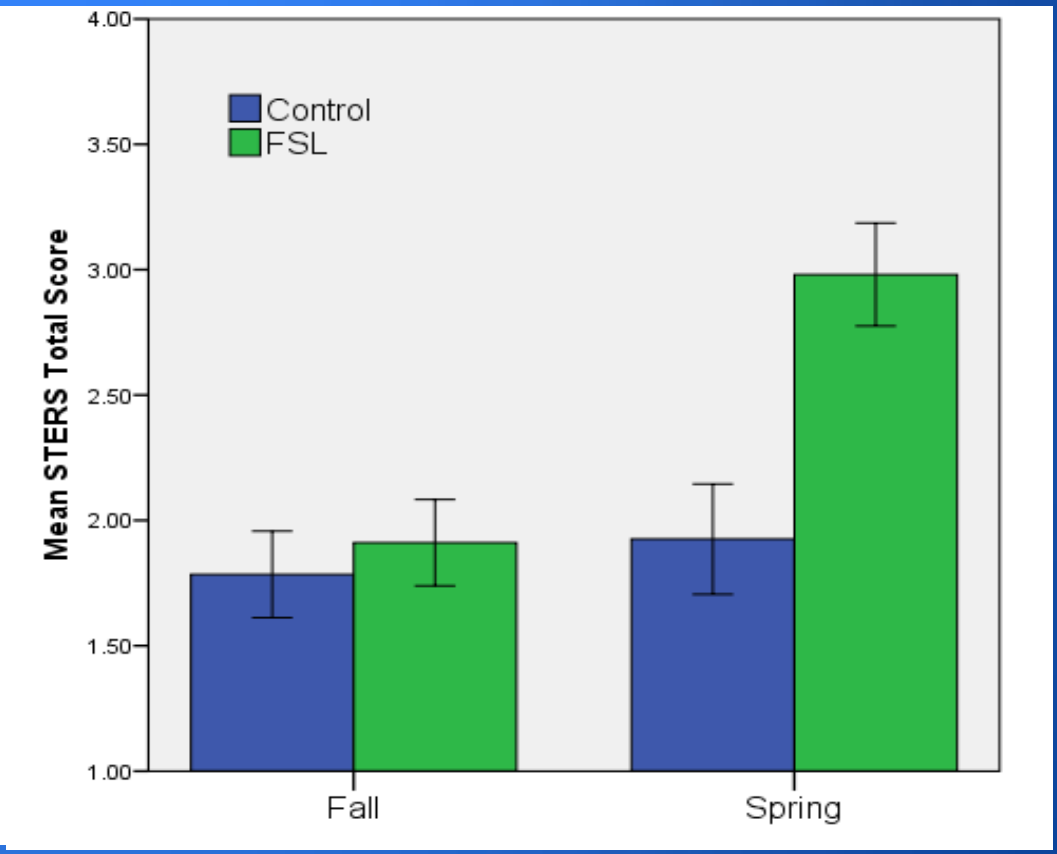
- Analysis of Science Teaching *(video vignette)*
- Interpreting a Child's Work *(photo of a representation)*
- Analysis of Misconceptions about Water Flow *(transcript)*
- Planning a Science Experience *(brief classroom scenario)*

Teacher & Classroom Results

Teacher Pedagogical Content Knowledge



Quality of Science Instruction



Limited preliminary findings for children

Children in FSL teachers' classrooms are better able to adjust predictions based on their experiences than children in the control classrooms.

New Courses: Discovering Nature and Building Structures

- Tested with a cohort of 25 teachers in Hartford in collaboration with the Connecticut Science Center: October 2012—December, 2013
- First time we have offered more than one course to the same cohort
- Revised and currently teaching the first of the three courses to a second cohort of teachers: September, 2013—December, 2014

Ongoing challenges

- Teachers need ongoing support in facilitating children's learning
- Teachers need support in assessing children's current science understanding
- Teachers need support in clarifying learning goals
- Teachers need support in planning meaningful experiences for children

Professional Development

- How much science (content and practices) would be helpful for teachers and how should it be taught?
- What is the optimal ratio of practices to content? Content to pedagogy?
- What instructional strategies are generic? Specific to STE?
- What is the value of a full course? workshops?
- What is the role of in-class support and how important is it?
- What are indicators of success for teachers? Children?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