Science IDEAS: Integrating Reading/Language Arts within Science Instruction Across Grades K-5

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Presentation at the Literacy for Science in the Common Core ELA Standards and the Next Generation Science Standards Workshop, Washington, DC.

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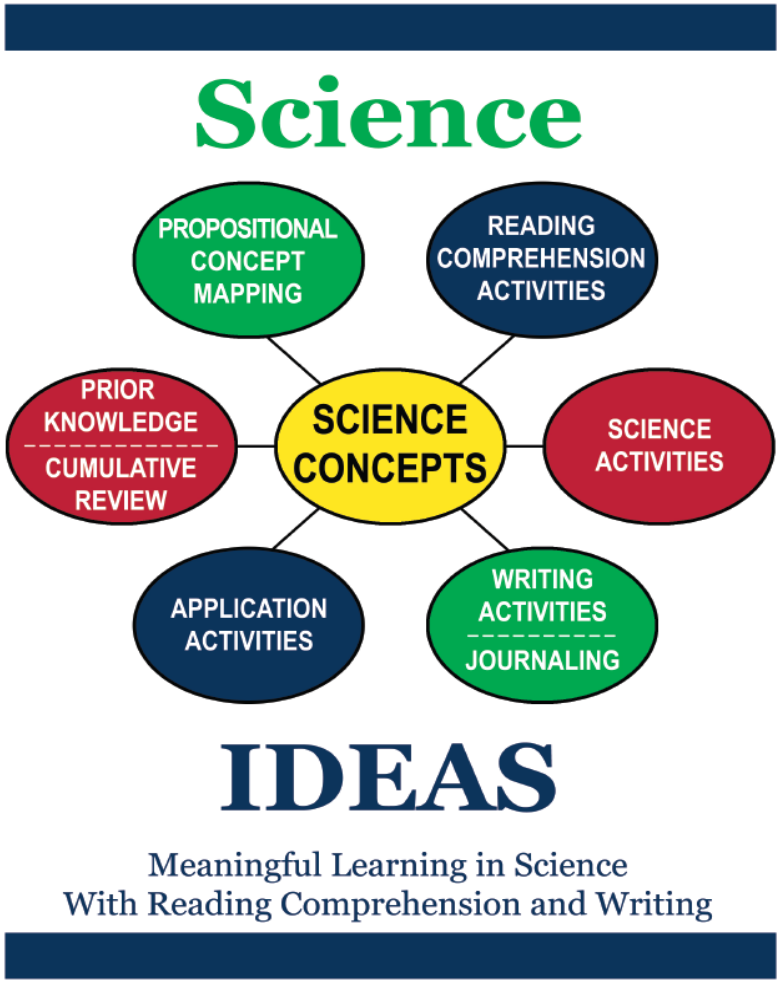
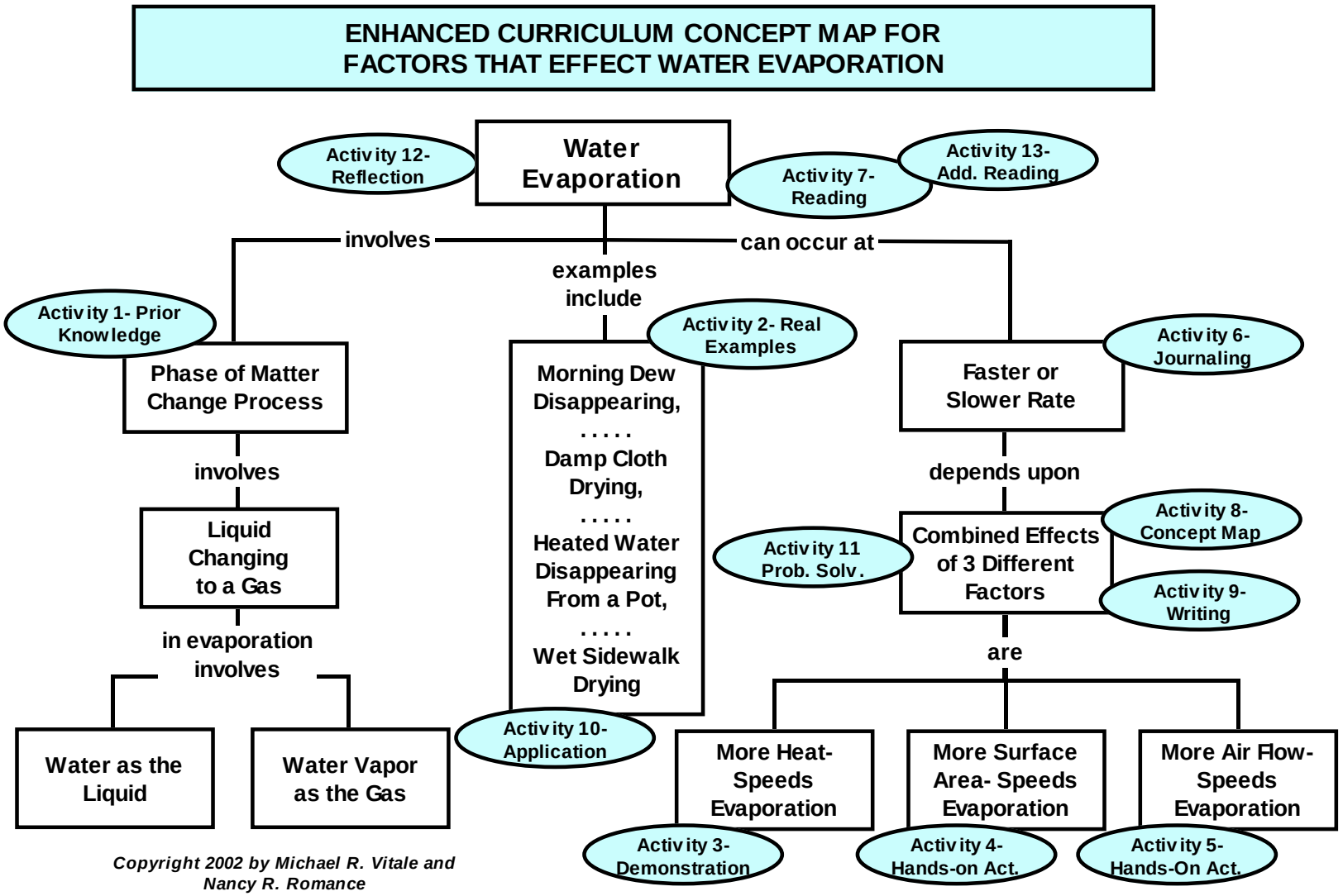
Presentation Overview

- Overview: Science IDEAS Model (Grades 3-5)
  - Integration of literacy within science instruction
  - Increased time for science instruction by replacing reading/language arts (except literature)
  - Multi-year research findings: Achievement effects- Science and Reading
- Interdisciplinary Perspectives that Support Model (Why the Model Works)
- Implications for Linking CCSS and NGSS
- Addressing CCSS at the Elementary and Secondary Levels
- Science IDEAS Model for Linking CCSS and NGSS
- Conclusions/Questions

Science IDEAS Model: Grades 3-5



Science IDEAS Model: Grades 3-5

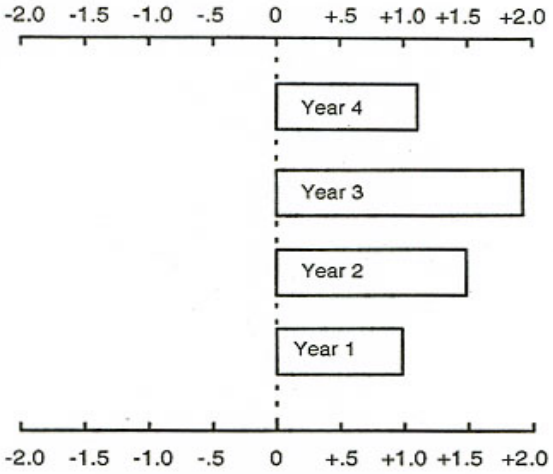


Science IDEAS Model: Grades 3-5

- General Student Classroom Experience
  - Always learning more about what they are learning
  - Using what they have learned as prior knowledge for subsequent learning
- Specific Student Classroom Experiences
  - Multiple hands-on/inquiry activities directly linked to reading across multiple science sources focused on the same set of concepts
  - Continuous journaling opportunities to write about, reflect on and explain how evidence gathered during inquiry activities links to the concepts being learned
  - Use of propositional concept maps to organize and represent knowledge learned

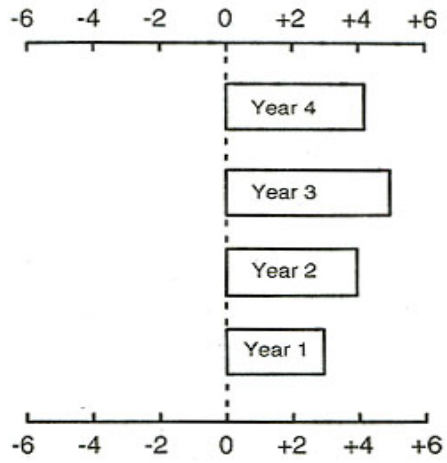
Science IDEAS: Multi-Year Research Findings

Early Years: 199 - 2001



Note-- Year 1 students = grade 4; average/above average
Year 2 students = grade 4; average/above average
Year 3 students = grades 4,5; at-risk
Year 4 students = grades 4,5; average/above average/at-ris

Science Achievement Effects
(E vs. C) in GE Years



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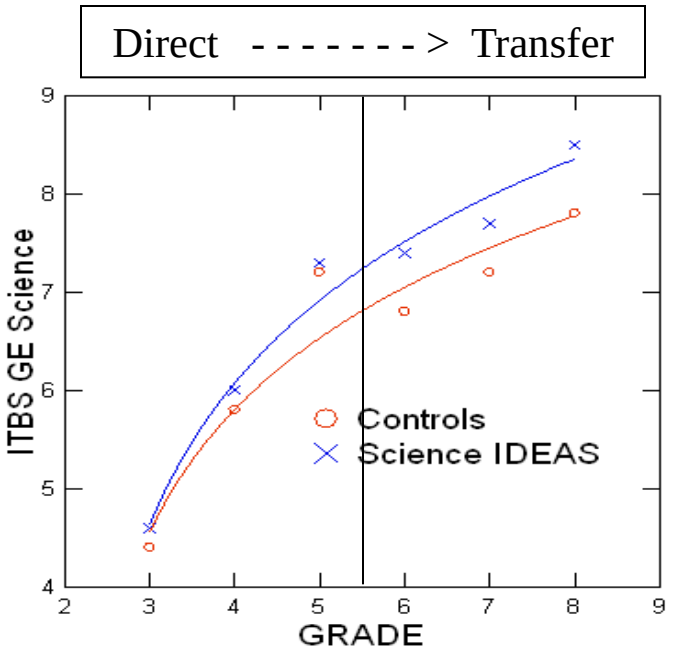
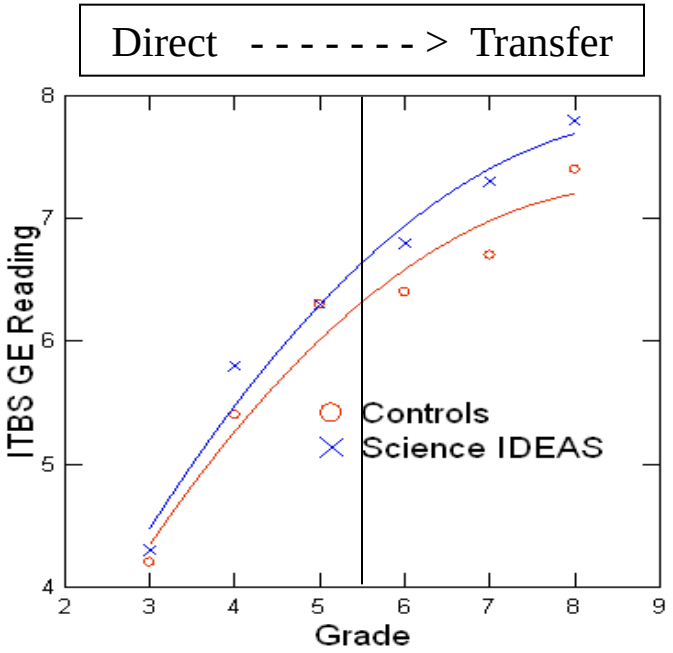
Reading Achievement Effects
(E vs. C) in GE Months

Science IDEAS: Multi-Year Research Findings

Recent Longitudinal Study: 2002-2007



Science GE Achievement Effects (E vs. C): Grades 3-8

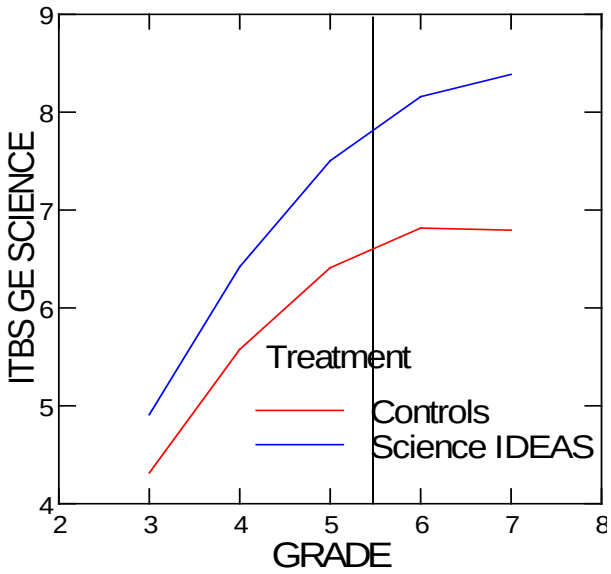


Reading GE Achievement Effects (E vs. C): Grades 3-8

Science IDEAS: Multi-Year Research Findings

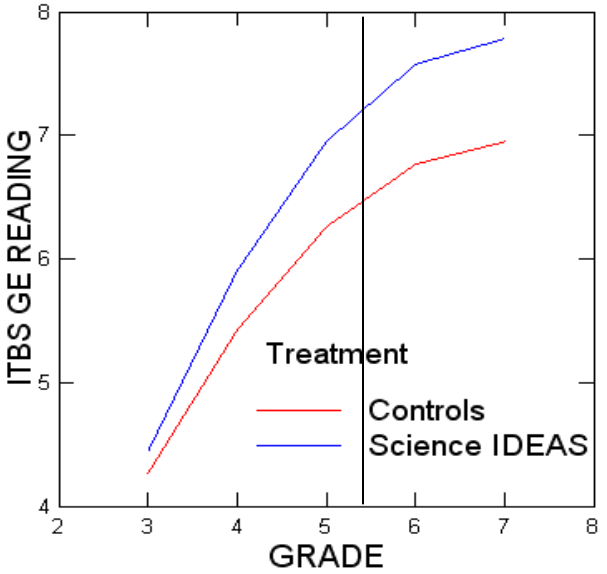
Recent Longitudinal Study (Replication): 2003-2008

Direct - - - - - - - > Transfer



Science GE Achievement
Effects (E vs. C): Grades 3-7

Direct - - - - - - - > Transfer



Reading GE Achievement
Effects (E vs. C): Grades 3-7

Science IDEAS: Multi-Year Research Findings

- Four early studies teacher/classroom oriented (1992-2001)
  - Adj. GE (E vs. C) effects on MAT Science: (Range: +.93 GE to + 2.3 GE)
  - Adj. GE (E vs. C) effects on ITBS Reading: (Range: +.33 GE to + .51 GE)
- Recent Longitudinal Studies
  - Schoolwide implementations: Grades 3-5 (N=12 schools)
  - Assessment of direct (grades 3-5) and transfer effects (grades 6-8)
    - 2002-2007: Adj, GE (E vs. C) effects: Grades 3-8
      - ITBS Science (+.38 GE)
      - ITBS Reading (+.32 GE)
    - 2003-2008: (Replication): Adj, GE (E vs. C) effects: Grades 3-7
      - ITBS Science (+ 1.03 GE)
      - ITBS Reading (+ .53 GE)
- Adaptations to K-2 (E vs. C) effects (Grade 1-2 tested)
    - 8-week study: ITBS Science (+.42 GE). ITBS Reading (Grade 2) (+.72 GE)
    - 1 year study: ITBS Science (+.16 GE). ITBS Reading (+.58 GE)

Interdisciplinary Perspectives in Support of the Model

- Concept of Expertise and How Experts Operate (Bransford et al.)
  - Well-organized conceptual knowledge
  - Knowledge accessed and applied with automaticity
- Strong vs. Weak Problem Solving/Application (Anderson)
  - Transformation of declarative to procedural knowledge
  - Distinction between actions that are knowledge-based and those that are not
- Knowledge-Based Instruction/Intelligent Tutoring Systems (Brown et al.)
  - Structure of disciplinary knowledge provides framework for all instructional events
  - Insures instructional events are related in coherent fashion
- Reading Comprehension Addressed as a Subset of Meaningful Learning (Vitale & Romance)

Implications for Linking CCSS and NGSS

- CCSS and Content-Area Learning (as NGSS-focused instruction)
  - Raising the Question of CCSS and NGSS Directionality
    - Cognitive science research evidence argues that knowledge serves as the basis for advanced applications and meaningful learning
    - Rich content knowledge must be developed cumulatively within and across grades
    - Arguably, rich content knowledge provides a foundation necessary for the development of student proficiency with CCSS standards
  - CCSS recognize the importance of building in-depth student content knowledge (but)…the emphasis of CCSS standards are on general literacy not on meaningful content learning
    - CCSS are suggestive that teaching each standard will in some way further meaningful content learning
    - CCSS standards don't incorporate the importance of cumulative meaningful learning as a basis for student literacy development

Implications for Linking CCSS and NGSS (Continued)

- Role of science in developing CCSS performance is logically the same at the elementary and secondary levels
  - Instruction at all levels should focus on in-depth understanding of core disciplinary concepts and concept relationships (e.g., NGSS)
  - Resulting disciplinary knowledge (NGSS) should be used as a foundation for CCSS literacy standards (e.g., reading, listening, writing, speaking)

Science IDEAS Model: Linking CCSS and NGSS

- Meets the requirement of developing in-depth science knowledge (NGSS) as a foundation for CCSS
  - Addresses conceptual science understanding in focused fashion
    - Hierarchically organized concepts and illustrative examples (for referential meaning)
    - Concept to concept relationships (for IF/THEN predictions)
    - Explanations of why phenomena occur (as abductive reasoning)
  - Incorporates argumentation and critical evaluation using science knowledge
- Includes science concept-based instruction in which propositional concept mapping provides an organizational framework for reading, listening, writing, and communication
- Is feasible to implement in K-5 settings

Science IDEAS Model: Linking CCSS and NGSS (Cont.)

- Provides an evidence-based argument for increasing instructional time allocated to science instruction in which CCSS literacy could be integrated
- The grade 3-5 model is extensible to secondary content-area instruction
  - Advanced ideas instructional components provide transition from grade 5 Science IDEAS to grade 6 middle schools science instruction
  - Science IDEAS-based model for secondary content-area instruction consists of teacher planning and student-focused strategies
    - Teacher planning (e.g., focusing on core concept relationships, building propositional concept maps as instructional guides)
    - Student-focused (e.g., knowledge-focused reading comprehension strategy, student involvement in propositional concept mapping, use of instructional design strategies to accelerate student learning and assess mastery)

Conclusions and Questions

- Interpretation- NGSS science standards provide a content-based foundation for successful CCSS implementation across grades K-12
- Interpretation is supported by consensus research findings from cognitive science and related disciplines
  - Expert practices and development (expertise)
  - Knowledge-based problem solving
  - Knowledge-based instruction
  - Reading comprehension as a subset of meaningful learning
- Science IDEAS is an instructional model whose architecture could provide a sound foundation for CCSS standards in grades K-5 in a manner that would facilitate transfer to CCSS standards at the secondary level.

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