Science Integration Through Literacy

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Dr. Nancy Romance

- Dr. Nancy Romance is Professor of Science/Literacy for the Department of Teaching and Learning in Florida Atlantic University (FAU)'s College of Education (COE)
- Dr. Romance is PI on a current NSF DR K12 project investigating the impact of Primary Science IDEAS on science and reading comprehension in grades 1-2
- She has studied the model for many years. Her work has been recognized by The National Reading Panel (2001), National Association for Research in Science Teaching (1992), the National Research Council, 2014, and the Johns Hopkins Center for Research and Reform in Education (2014)

Objectives

-To understand the objectives of the Science IDEAS model

-To observe how the 5 E Model of Science Instruction links naturally to Elements of the Science IDEAS Model

-To view student achievement results in reading and science resulting from implementing Science IDEAS in authentic elementary classrooms in Florida

Why Science Integration with Reading?

- Time demands on classroom teachers
  - separate content silos compete for teaching time during school day
- Reading comprehension builds through cumulative development of science content knowledge
  - leads to higher reading comprehension
- Content integration leads to understanding of real world applications
  - students apply knowledge to new problems

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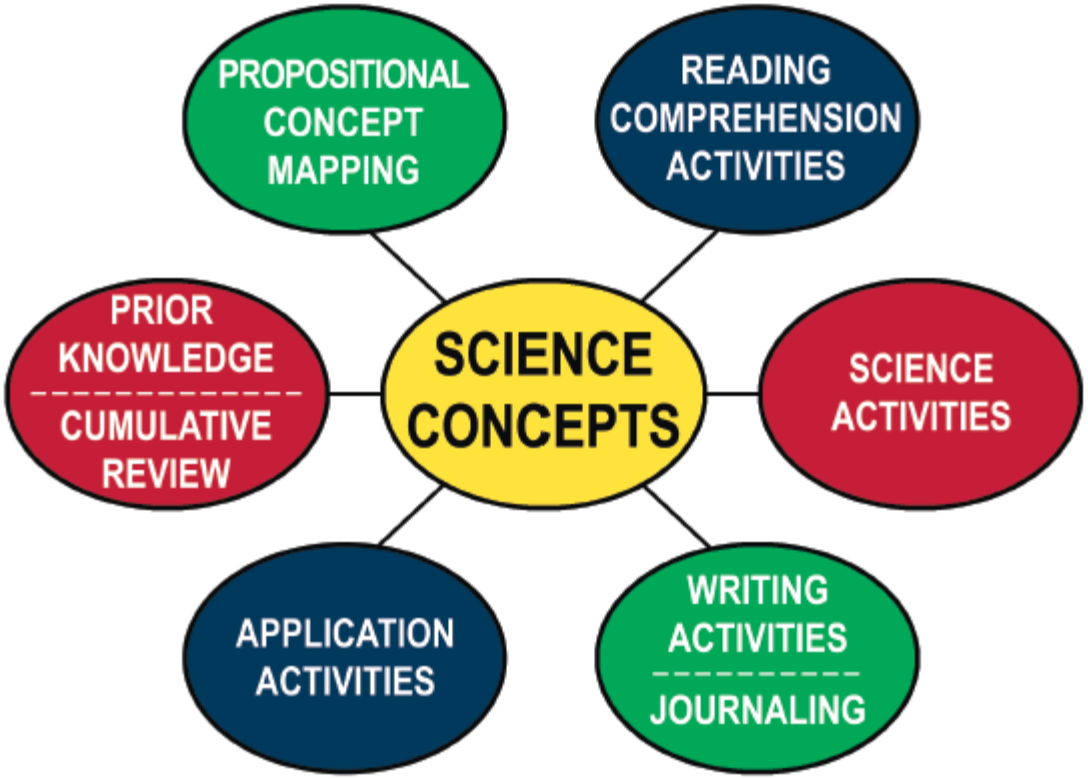
Science IDEAS
A Research-Validated Instructional Model


PROPOSITIONAL CONCEPT MAPPING
READING COMPREHENSION ACTIVITIES
PRIOR KNOWLEDGE
CUMULATIVE REVIEW
SCIENCE CONCEPTS
SCIENCE ACTIVITIES
APPLICATION ACTIVITIES
WRITING ACTIVITIES
JOURNALING

Science IDEAS Model: Instructional Elements

- **Science IDEAS elements function as a set of integrated learning activities used in grades 3-4-5**
  - ***Science Investigation / Inquiry:*** Use of hands-on activities with guided /open-ended inquiry, concept verification, practices of science
  - ***Reading Comprehension***: Specific strategy for guiding student reading of informational text to enhance deep understanding
  - ***Propositional Concept Mapping***: Strategy for visual organization and representation of science concepts and concept relationships
  - ***Journaling and Writing***: Guiding students to record their understanding/thinking and questions as a basis for review/and to enhance the quality of their expository writing
  - ***Application Activities / Projects***: A wide variety of activities in which students apply what they have learned
  - ***Prior Knowledge / Cumulative Review***: Strategy for accessing prior curricular knowledge and for scheduling curricular review

Interdisciplinary Foundations of Project

- Use a science curriculum in which the concepts are conceptually-organized and meaningfully sequenced (Florida Standards)
- Provide an integrated science, reading and writing curricular environment
- Focus on core concepts that support problem-solving and reading in science
- Link content knowledge to the skills of inquiry that then become automatic

Science IDEAS Model

- An instructional model funded by NSF/IERI/DR-K12 is designed to accelerate student achievement in science, reading comprehension and writing.
- In grades 3-4-5, Science IDEAS integrates reading comprehension and writing within daily, 1.5 hour instructional block that focuses on science concepts writing/journaling and actively engages students in exploring science phenomena.
- In grades 1-2, it integrates 15 minutes of reading comprehension with 30 minutes of science daily (i.e., a 45 minute instructional block)

Overview Science IDEAS Project: 1992-2017

- Science IDEAS began as a study of 3 fourth grade classrooms in 1992
- Expanded to 50 classrooms to include fifth grade
- In 2002, NSF/IERI funded the project for third through fifth grade, multiple schools, and school-wide implementation (all 3-4-5 classrooms)
- In 2014, NSF/IERI funded the project for first and second grades, multiple school, schoolwide implementation

Major Objectives for Implementing Science IDEAS

- Implement Science IDEAS on a schoolwide basis in an increasing number of elementary schools
- Validate the professional development and support components for fidelity of implementation
- Document the direct effects of the Science IDEAS model on student achievement (vs. comparable students) in reading comprehension and science as measured the ITBS nationally-normed tests across grades 1 through 5

continued

- Document the transfer effects from grades 3-4-5 to grades 6-7 and from grades 1-2 to grade 3 on ITBS reading comprehension and science achievement
- Use the project website, teacher instructional binders, and multiple classroom non-fiction science libraries to support schools in the process of implementation of the model
- Note: Project funded by NSF IERI (2003-2009) and NSF DR K12 (2013-2018)
- www.scienceideas.org

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How Elements of the Science IDEAS Model links Conceptually to the 5 E Model of Science Instruction

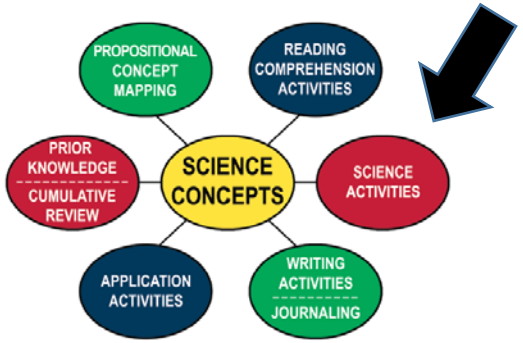
Components of the 5 E Model of Science Instruction

- Engage
- Explore
- Explain
- Elaborate
- Evaluate

Science Activities/Engage/Explore

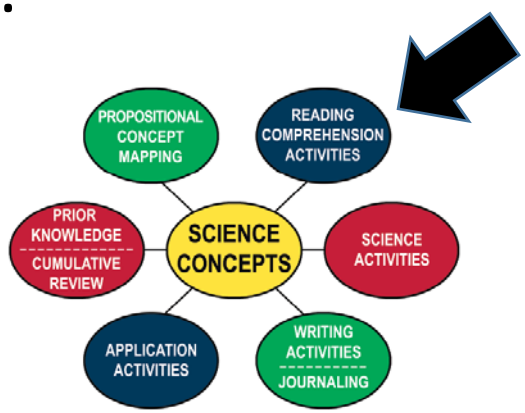
- Students engage in multiple hands-on science exploration activities focusing on a science concept or group of related concepts

  For example: Students participate in a STEM project where teams build a waterwheel or they investigate how many ways the process of evaporation can be speeded up.



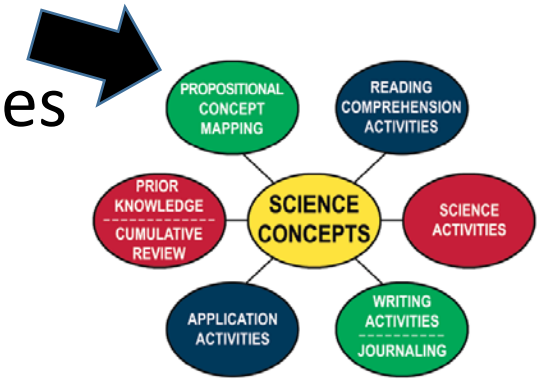
Reading Comprehension Strategy

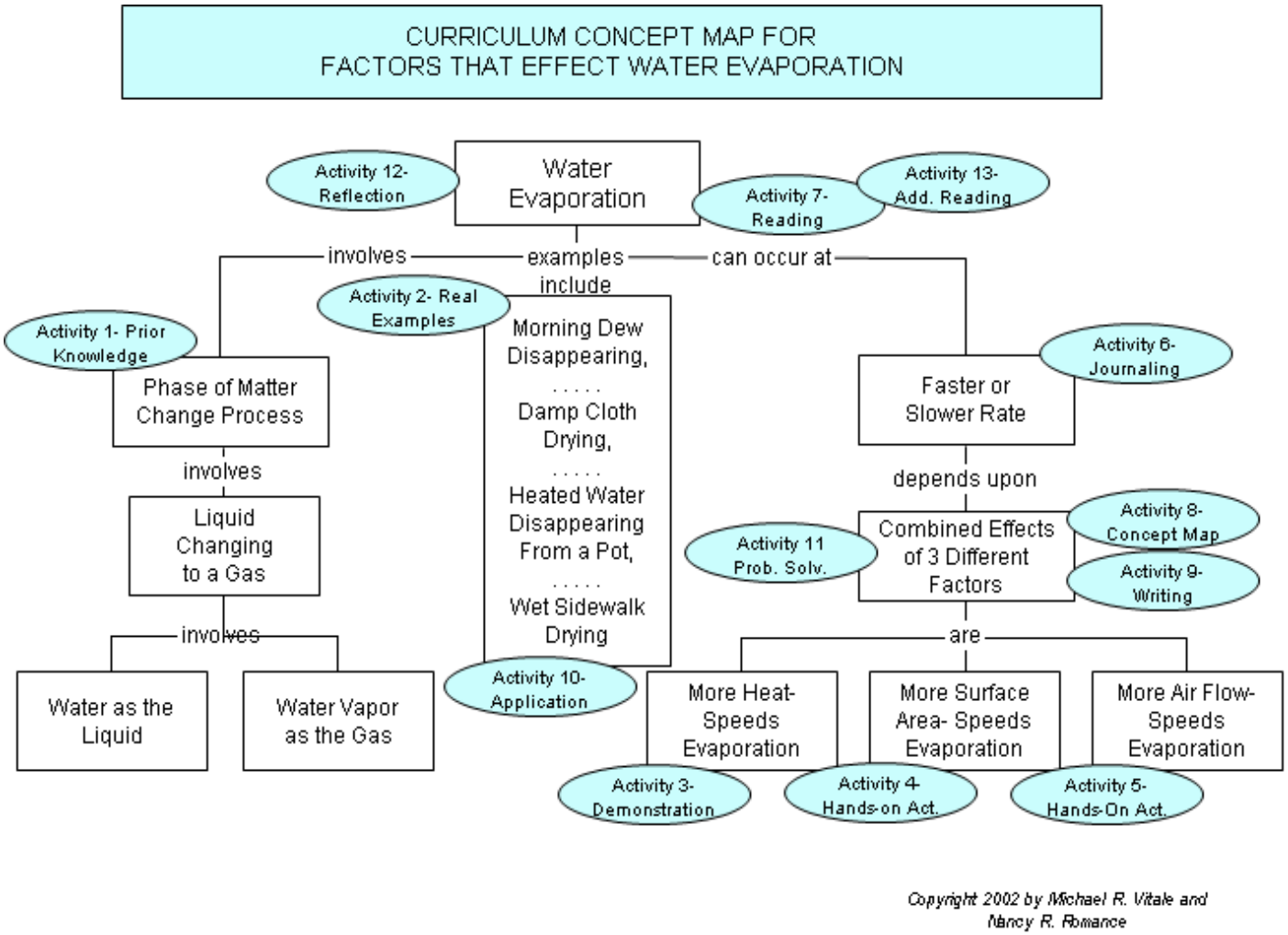
- Teachers apply a reading comprehension strategy to guide student access of prior knowledge and summarization of what is being read.
- Students read from multiple non-fiction reading sources that focus on the science concept or group of related concepts they are learning.



Propositional Concept Mapping/Explain

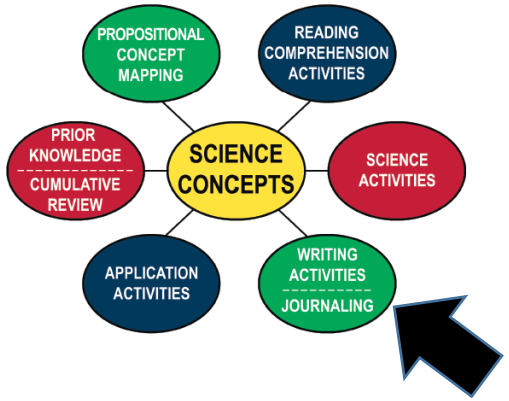
- Teachers model for students how to create a concept map as a way of summarizing what they have learned and to help them organize concepts in a logical way.
- Teachers guide students to make connections between concepts on their own.
- Maps can be added as journal entries document what has been learned.





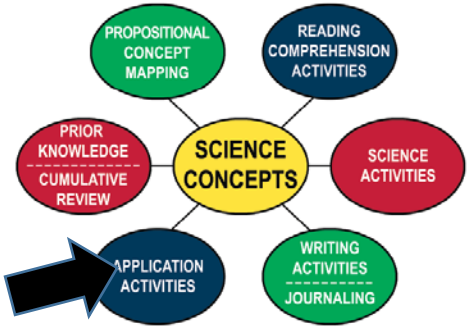
Journaling and Writing/Explain/Elaborate

- Concepts and concept maps can also be used for informational/expository writing.
- Student notebooks or journals can be used to promote organization of science concepts taught
- Journals are a cumulative record of concept-focused student activities. They include:
  - Ideas from books that have been read
  - summaries of investigations
  - propositional concept maps
  - questions they have



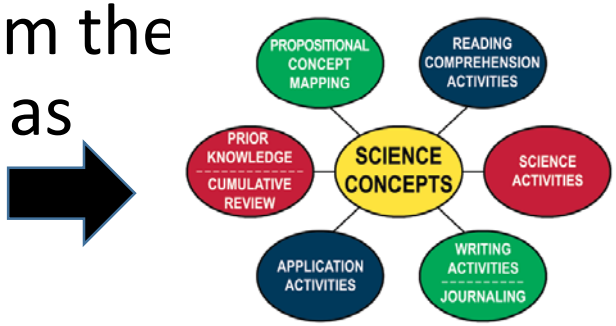
Application Activities/Explore/Elaborate

- Science IDEAS elements are easily organized and integrated by teachers as they guide students in learning about and exploring real-world phenomena along with key science concepts and key practices of science (inquiry)
  - For example:
  - Activity: Does Water in a Lake have Energy?
  - Activity: Reading books on the topic



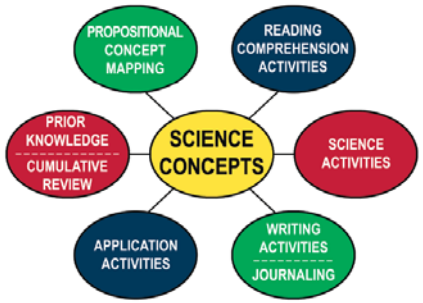
Prior Knowledge/Evaluate

- Multi-day lessons build upon each other and depend on students' accessing and using their prior knowledge
- Teachers question students daily about what they know about the previous lessons and display important concept-based vocabulary
- Concept maps can be created from the list of science concepts and used as a formative assessment



Cumulative Review/Evaluate

- Should occur about every 2-4 weeks during a unit of study.
- Teacher selects representative activities (reading materials, hands-on activities, propositional concept maps, writing/journaling) to be used in the review.
- Questioning and review of the activities used to teach concept(s).



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Science and Reading Achievement Results

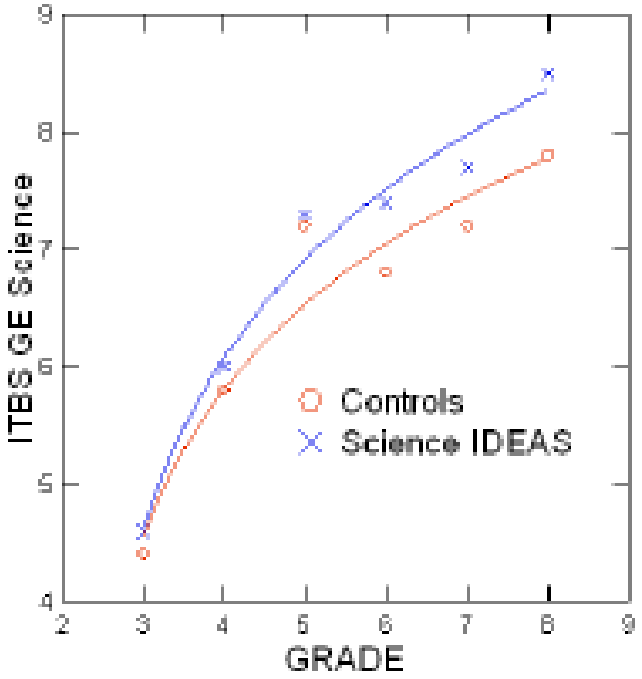
Student Achievement Results: Grades 1-2 and Grades 3-5

- Studies compared Science IDEAS students with other students in demographically similar schools.
- All studies showed increased achievement on nationally-normed ITBS tests in science and reading comprehension (vs. controls).
- The grade 3-5 Science IDEAS model was recognized as one of the most effective in accelerating student achievement measured by nationally-normed tests (Slavin, 2014, Johns Hopkins Center for Research and Reform in Education).

Representative Achievement Results: Grades 1-2 and Grades 3-5

Year	Grade	Exp. Duration	Participants	Effects of Science IDEAS on Student Ach. Science	Reading
1992	4	1 Yr.	3 Classes	+.93 GE (MAT)	+.35 GE (ITBS)
1998	4-5	1 Yr.	45 Classes	+1.11 GE (MAT)	+.37 GE (ITBS)
2002-2007	3-5	Multi-Year	12 Schools	+.38 GE (ITBS)	+.32 GE (ITBS)
			Note- Results include direct effects for grades 3-5 and transfer effects to grades 6-8		
2003-2008	3-5	Multi-Year	6 Schools	+1.08 GE (ITBS)	+.57 GE (ITBS)
			Note- Results include direct effects for grades 3-5 and transfer effects to grades 6-7		
2005	1-2	8 Wks.	2 Schools	+.42 GE (ITBS)	+.72 GE (ITBS)
2007	1-2	1 Yr.	2 Schools	+.16 GE (ITBS)	+.58 GE (ITBS)
2011-2013	1-2	Multi-Year	7 Schools	+.29 GE (ITBS)	+.32 GE (ITBS)
			Note- Results include direct effects for grades 1-2 and transfer effects to grade 3		

Middle School Transfer Effect



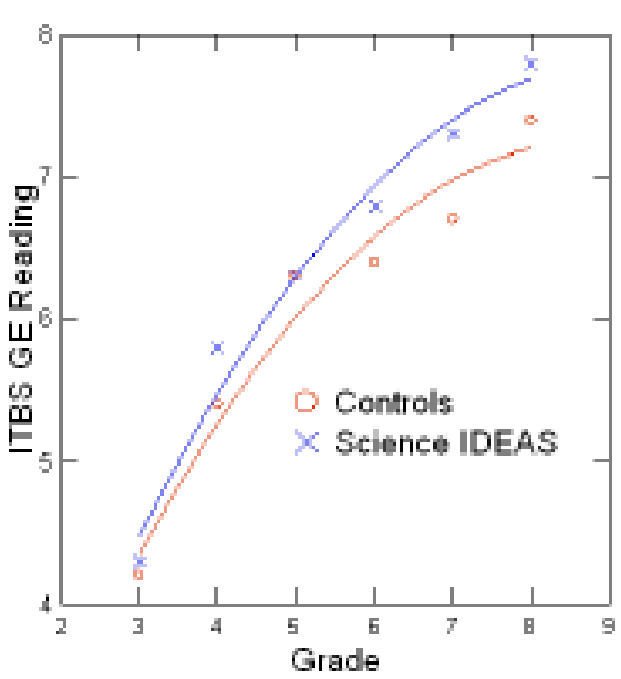


Figure 4. 2006-2007 Achievement Trajectories for Science IDEAS and Control Schools for ITBS Science and Reading. Since project was implemented in grades 3-4-5, performance of students in grades 6-7-8 represents a treatment-transfer effect.

School Accountability Grades 2002-2010

Elementary Schools Implementing Science IDEAS in Grades 3-5 Across Project Years 2001-02 Through 2007-08: School Accountability Grades

District	School Name	Grades	Avg. Minority	Avg. Free Lunch	PLANNING YR01-02	YR 1 YR02-03	YR 2 YR03-04	YR 3 YR04-05	YR 4 YR05-06	YR 5 YR06-07	YR 6 YR07-08	YR 7 YR08-09	YR 8 YR09-10
B	Challenger	3-5	37	72	B1	A	A	A	A	A	A	A	A
B	Silver Ridge	3-5	14	25	B2	A	A	A	A	A	A	A	A
A	Discovery Key	3-5	16	30	A1	A	A	A	A	A	A	A	A
A	Pointciana	3-5	48	62	A2	B	A	A	C	A	A	A	A
B	Nova Blanche	3-5	40	68	B3	A	A	B	A	A	A	A	A
B	Nova Eisenhowrer	3-5	39	68	B4	B	A	A	A	A	A	A	A
B	Oakland Park	3-5	72	78	B5	B	A	A	C	A	A	A	B
A	Boca Raton	3-5	64	61	A3	A	A	A	A	A	A	A	A
A	Lantana	3-5	70	63	A4	A	A	C	C	B	B	A	A
A	Sandpiper	3-5	20	36	A5	A	A	A	A	A	A	A	A
A	Heritage	3-5	72	69	A6	B	A	A	A	A	A	A	A
A	Elbridge Gale	3-5	32	50	A7					A	A	A	A

Note 1- The project began through an NSF Planning Grant in 2001-02. The NSF/IERI Project was implemented from 2002-03 through 2007-08. Year 6 (2007-08) and Year 7 (2008-09) were funded through no-cost project extensions.

Note 2- Shaded areas show years Science IDEAS was implemented. Grades were assigned by the Florida Statewide Accountability System

Selected Science IDEAS Research Publications

"Cumulative, in-depth science instruction results in substantial achievement acceleration of student reading comprehension proficiency along with increased science achievement."

-Romance and Vitale (1992, 2001, 2008, 2010, 2011, 2012, 2014, 2015, 2017) and Vitale and Romance (2006, 2007, 2009, 2010, 2011, 2012)

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School-Based Strategy for Initiating and Scaling Up Science IDEAS

Multi-Phase Implementation of Science IDEAS Model

Awareness of Curriculum Policy Issues

- Science IDEAS' (gr 3-5) research findings suggest the importance of cumulative content-area learning to increase achievement in reading comprehension grades 1-5
- Decreasing time for science hinders advancing student reading comprehension performance for "all" students
- Results suggest its added-value and the need for changes in policy and practice as it relates to allocated instructional time for integrated science-reading-writing and less time for narrative reading or skill development without content.
- Grades 1-2 results also suggest the importance of early learning using integrated science-reading and writing.

Multi-Phase Implementation of Science IDEAS Model

Follow Evolutionary Three-Phase Process

- **Initiate – Create and Fine-Tune Start-Up Model Schools** Use schoolwide implementation in model schools for capacity development
- **Establish Sustainability of Initial Model Schools** Through teacher PD, development of a teacher leadership cadre, principal leadership, grade level planning, district/area curricular support, monitoring of implementation/ achievement outcomes
- **Expand Model to New Schools** Use Model Schools and Teacher/Principal leadership and Area Administrators /District Curriculum Leadership as critical resources

Multi-Phase Implementation of Science IDEAS Model

Building School Capacity and Infrastructure for Sustainability and Expansion

- **Specialized Teacher Expertise**
  - Development of teachers' science content understanding
  - All grades - classroom implementation of Science IDEAS model
- **Teacher Leadership Cohort**
  - Serves as in-school mentors and problem solvers
  - Organizes and delivers summer professional development institutes
  - Serves on school and district curricular committees
- **Principal Leadership for Science IDEAS**
  - Support and management of grade level curricular planning
  - Monitoring and reporting implementation fidelity

Multi-Phase Implementation of Science IDEAS Model

Building School Capacity and Infrastructure for Sustainability and Expansion (Continued)

- **District Management Capacity and Infrastructure for Science IDEAS**
  - Monitor implementation status/fidelity and multi-year student achievement trends – using a system's approach
  - Observe Science IDEAS classrooms and participate in professional development
  - Professional development – for all new Science IDEAS' Principals
  - Professional development – District Curriculum Specialists and Area Superintendents for Curriculum and Accountability

Multi-Phase Implementation of Science IDEAS Model

Classroom Implementation Expectations

- **Students**
  - Motivated and engaged in learning tasks
  - Clear evidence of high quality work by all students
  - Display of high level of relevant background knowledge which is applied to new learning tasks
  - Enjoy reading as much as they enjoy "doing" science
  - Levels the playing field for 'all' students – addresses equity
- **Teachers**
  - Confidence in implementing the Science IDEAS Model
  - Increased expectations about what all students can achieve
  - Active engagement in curricular planning – at/across grade levels
  - Encourage more in-depth classroom discussions
  - Recognize model potential to support reading comprehension

Multi-Phase Implementation of Science IDEAS Model

Implications for Modified Accountability Practices

- **Raising Achievement Expectations through Assessment**
  - Changing the structure of grade 3-8 reading comprehension accountability assessment
    - Grades 3-8 : Focus on meaningful content-area understanding vs. "general" reading skills
    - Grades K-2 : Use nationally-normed reading tests
  - Interpret performance in grades 3-8 to projected levels of success in HS content-area courses (via achievement trajectories)
  - Emphasize NRT achievement of students in K-2 and in HS content-area courses as the focus of accountability
- **Disaggregate student performance to measure school effectiveness**
  - Students continuously enrolled K-5 or K-8
  - Students enrolled for only complete school years
  - Remaining students enrolled only for portion of school year

Implications: Research and Curriculum Policy

- Romance, N. R., & Vitale, M. R. (2011). *An interdisciplinary model for accelerating student achievement in science and reading comprehension across grades 3-8: Implications for research and practice.*
- Vitale, M. R., & Romance, N. R. (2009). *A research-based model for integrating elementary science and reading comprehension: Implications for research and practice.*
- Romance, N. R., & Vitale, M. R. (2009). *Perspectives for improving school instruction and learning: An interdisciplinary model for integrating Science and Reading in Grades K-5.*
- www.scienceideas.org

Contact

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Survey

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Date of presentation: 2/16/2018

Time of session: AM

Presenter: Cassie Palelis

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