PROJECT READi

Reading, Evidence, and Argumentation in Disciplinary Instruction

READI for Science – Yes They Can!

National Symposium on Reading for Understanding

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Reading, Evidence, and Argumentation in Disciplinary Instruction

Funded by the Reading for Understanding Initiative of the Institute for Education Sciences, U.S. Department of Education, through Grant R305F100007 to University of Illinois at Chicago. The opinions expressed are those of the authors and do not represent views of the Institute or the U.S. Department of Education.

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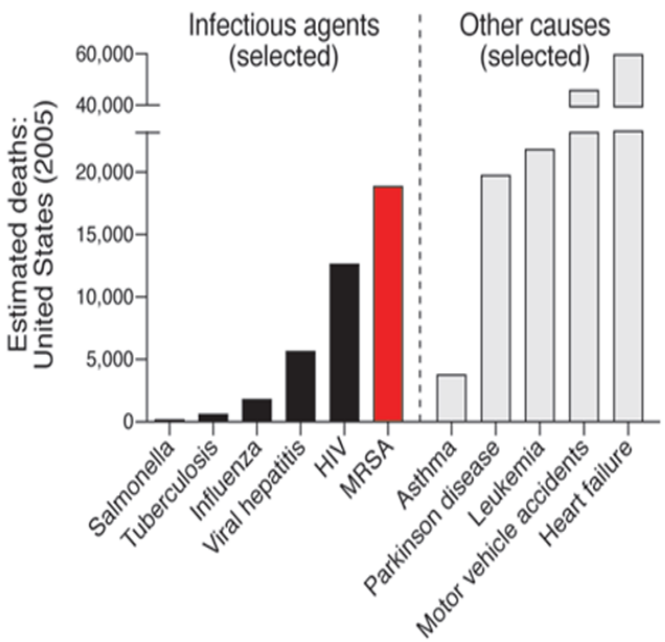
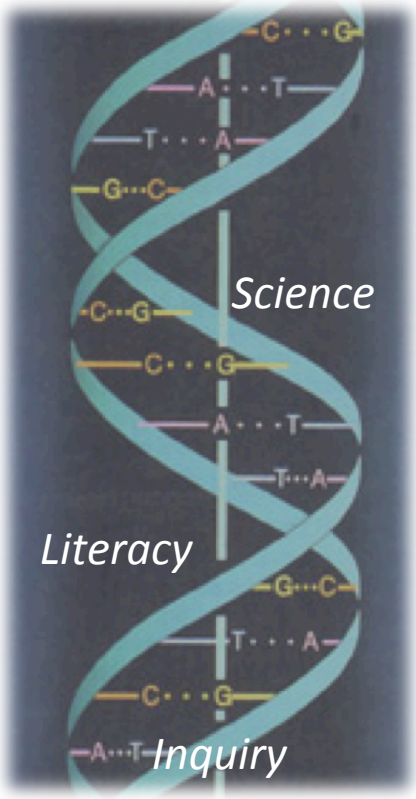
Science Texts are Varied and Complex



(C) Comparison of estimated deaths in the United States in 2005 due to individual infectious agents or other causes. Data are CDC estimates from National Vital Statistics Reports (12) and Klevens et al. (11). Deaths associated with MRSA infection are based on the estimated number of in-hospital deaths rather than attributable mortality, whereas data for all other causes of mortality are based on US Standard Certificate of Death. Note also that mortality due to MSSA is not included, and thus estimated mortality associated with all S. aureus infections is not shown.

let's explore
world inside

Designing an Approach to Reading Science *as Doing and Learning* Science



Goal: to *simultaneously* develop students'

- science knowledge
- interest and engagement in science learning
- participation in inquiry practices
- ability to make meaning of science texts for scientific purposes
- reading for understanding in science

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NGSS Practices and READI Science Student Learning Goals

READI Science Learning Goals	
1	Engage in close reading of a range of science representations
2	Synthesize evidence and information across multiple sources
3	Construct, justify, and critique explanations and explanatory models
4	
5	
6	Demonstrate understanding of the epistemology of science

NGSS STEM Practices
1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Developing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

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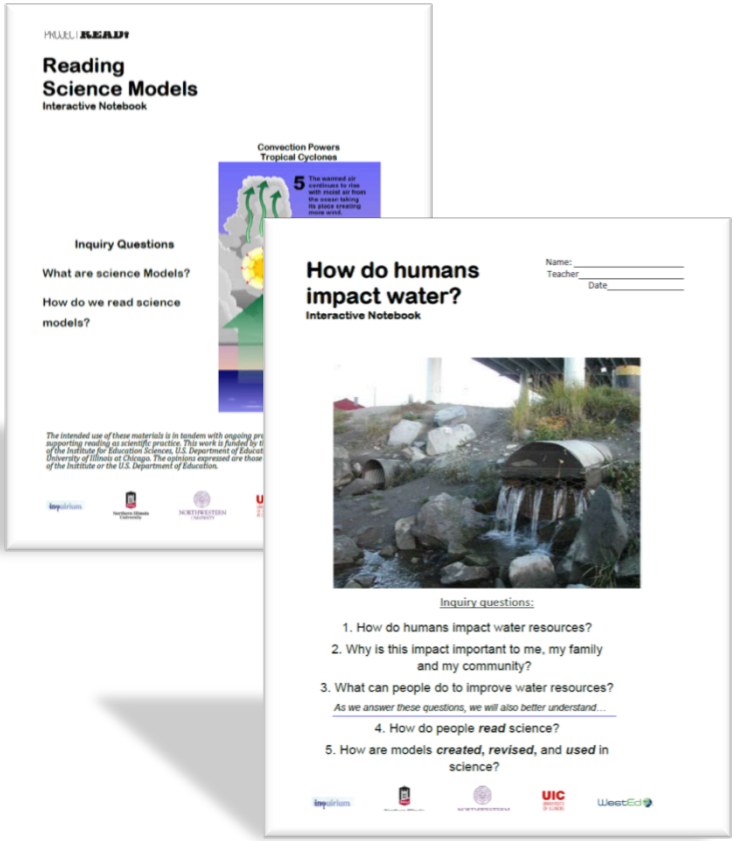
Text-Based Investigation Modules

Middle School

- Human Impact on Water Resources module and Human Impact on Carbon Cycle Pre/Post Assessment – Earth Science
- Reading Models Mini-Unit
- MRSA Module and Pesticide-Resistant Head Lice Pre/post assessment –Life Science
- Teacher developed modules

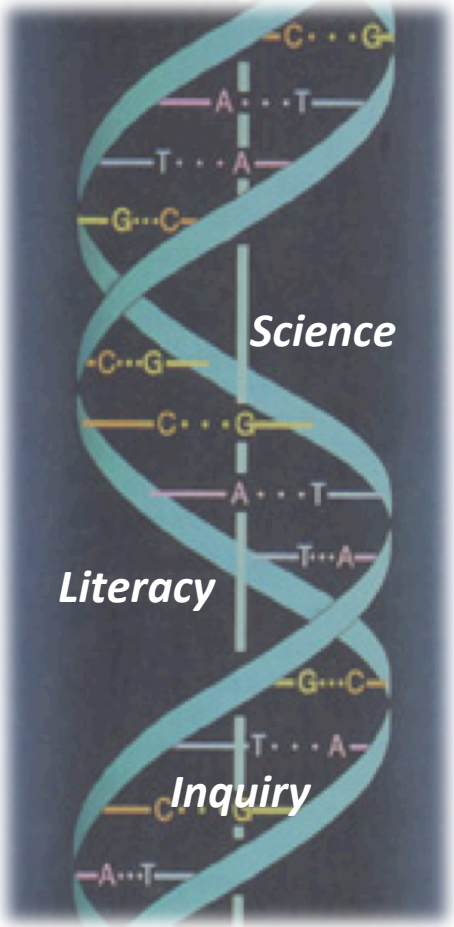


Text-Based Investigation Modules

High School

- Methicillin Resistant Staph Aureus module and Malaria Pre/post assessment –Life Science
- Reading Models Mini-Unit, Life Science
- Homeostasis – Life Science
- Cell Theory Text Set – Life
- Teacher developed modules

Building Science Teacher Capacity to Teach Literacy as Science Inquiry Practice



Goal: to develop science teachers'

- understanding of inquiry practices – constructing and critiquing explanatory models
- understanding of science literacy practices – close reading and sensemaking to model and explain
- understanding of texts – varied forms, structures, and challenges
- pedagogical repertoire – metacognitive routines, text-based discussion, formative assessment

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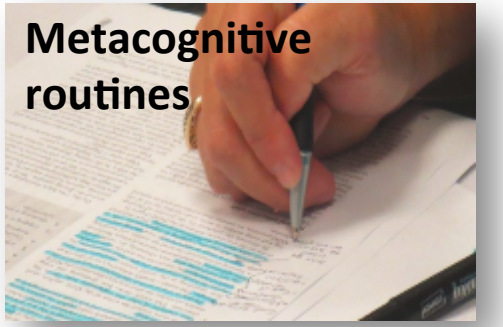
Models of Professional Learning to Tap and Build Teacher Expertise



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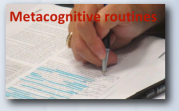
READI for 9th Grade Biology: Yes They Can

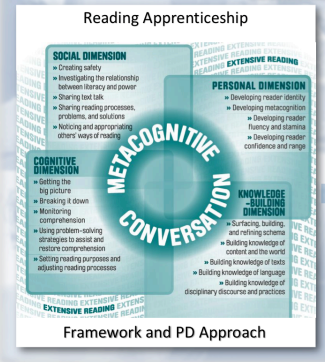
Teachers mediate students' opportunities to learn. Teachers need opportunities to engage with the knowledge, skills, and practices they will facilitate for their students.

11-day professional development series | Fall semester implementation

Winter 2014 — Spring 2014 — Summer 2014 — Fall 2014 — Winter 2015

READI RCT Professional Development: Integrating Reading Apprenticeship and READI Learning Goals





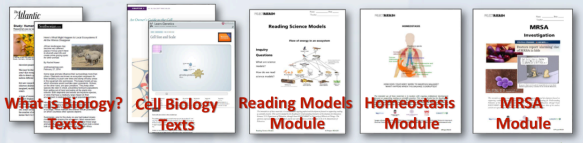
READI Science RCT PD Design

Days 1-4	Building classroom routines to support science literacy
Days 5-9	Building science literacy and discourse: Reading for modeling, explanation and argumentation Planning modules into the semester
Days 10-11	Deepening science literacy and discourse: modules as educative curricula, formative assessment & responsive instruction

READI Science Learning Goals

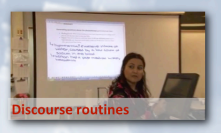
- Engage in close reading of a range of science representations; identify, analyze and interpret scientific evidence in texts/sources including graphs, diagrams, models, exposition
- Synthesize evidence and information across multiple sources including graphs, diagrams, models, exposition
- Construct, justify, and critique explanations and explanatory models of science phenomena from scientific evidence drawn from multiple sources and using science principles, frameworks, and enduring understandings
- Demonstrate understanding of the epistemology of science through inquiry dispositions and conceptual change awareness/orientation; generate inquiry questions, monitor their changing conceptions through multiple encounters with text, tolerate ambiguity, seek "best understandings given the evidence."

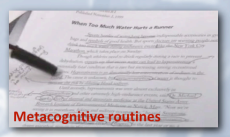
READI Practices × Content

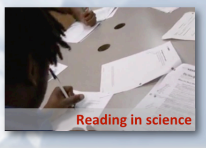


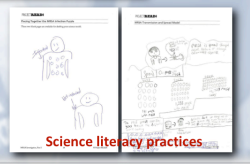
READI modules and instructional sequence

Building classroom routines to support science literacy and meaning making	Building a repertoire of science literacy and discourse practices	Deepening scientific literacy and discourse practices for reasoned sensemaking	Utilizing scientific literacy and literacy practices for knowledge building









Study Design

SAMPLE
- Stratified random sample at school level
- 6 strata based on prior school level achievement
- 12 schools assigned to intervention and 12 to comparison

PARTICIPANTS
- 24 Teachers in READI intervention; 24 comparison – business as usual
- Randomly selected two classes from each teacher
- Analyzable data from approximately 1400 students (60% Intervention)

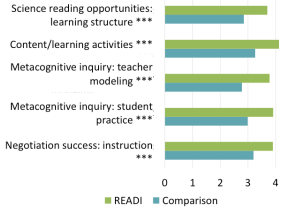
TREATMENT
- For READI teachers: professional development
- For READI Students: READI teachers implemented "semester" – long intervention (20 to 22 weeks)

ASSESSMENTS PRE AND POST
- TEACHERS: Survey, classroom observation early, late in semester
- STUDENTS: Comprehension (RISE at pre; GISA at post); explanation; epistemology

Results

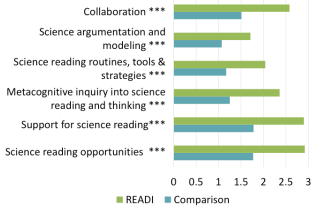
TEACHERS: READI and comparison teachers did not differ on survey responses prior to PD. There were significant differences between the two on all constructs related to practices at the conclusion of the intervention, with READI teachers showing significantly higher ratings.

Teacher Practice Survey (post)



***Cohen's *ds* ranged from 1.34 to 1.88.

Teacher Practice Observations (late)



***Cohen's *ds* ranged from 1.07 to 1.58.

STUDENTS: READI and comparison students did not differ on comprehension at pre. Post intervention READI students outperformed comparison students on the ETS-developed GISA multiple source comprehension assessment.

Student Learning Outcomes	READI n = 672	Comparison n = 539
Post		
GISA (post)***	58.76% (16.14)	54.85% (17.36)
Science epistemology scale 1: Corroboration using multiple sources**	4.86 (0.69)	4.74 (0.75)
Science epistemology scale 2: Science is tentative and complex, not simple and certain	2.94 (0.83)	2.92 (0.82)
Self-efficacy/confidence in doing science	3.58 (0.84)	3.53 (0.84)
Pre		
RISE	271.33 (13.47)	270.01 (13.95)
Science epistemology scale 1: Corroboration using multiple sources	4.81 (0.68)	4.83 (0.72)
Science epistemology scale 2: Science is tentative and complex, not simple and certain*	2.76 (0.81)	2.85 (0.81)
Self-efficacy/confidence in doing science	3.60 (0.81)	3.62 (0.79)

Note. * p < .05; **p < .01. *** p < .001.

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Northern Illinois University: Dylan Blaum, M Anne Britt, Brent Steffens, Patricia Wallace

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Katherine McIntyre and Students

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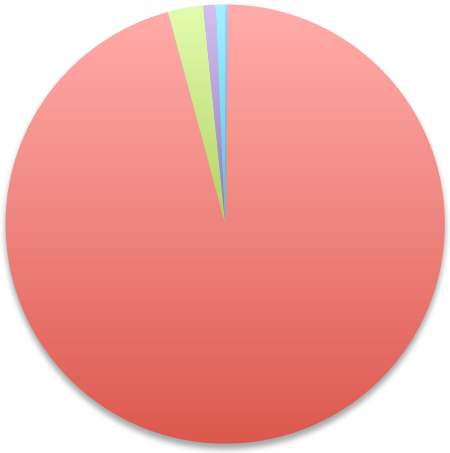
preK-8 Elementary School
Chicago Public Schools

-neighborhood school
-South side of Chicago
-430 students



- Asian American
- African American
- Hispanic
- White
- Other

Other Statistics

• Low Income	93.0%
• Diverse Learners	15.3%
• Limited English	1.6%

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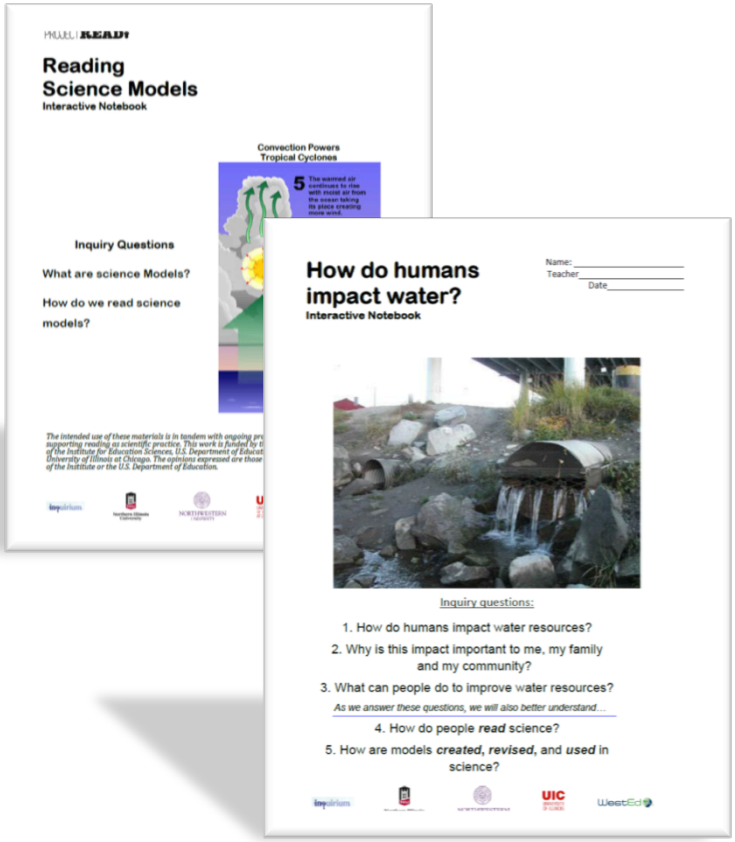
Literacy Struggles in Urban Classroom With Students of Low SES Backgrounds

- Lacking academic background knowledge
- Gaps in general science knowledge
- Many students not reading on grade level
- Low academic vocabulary knowledge
- Low science specific vocabulary knowledge

My Participation in Project

- Implemented READI modules in 6th grade science classroom
  - Models mini-module
  - Water Module
  - MRSA Module



- Overlaid READI principles onto school-based curriculum to develop:
  - Energy Resources Unit
  - Fossils Unit
  - Dynamic Planet Unit

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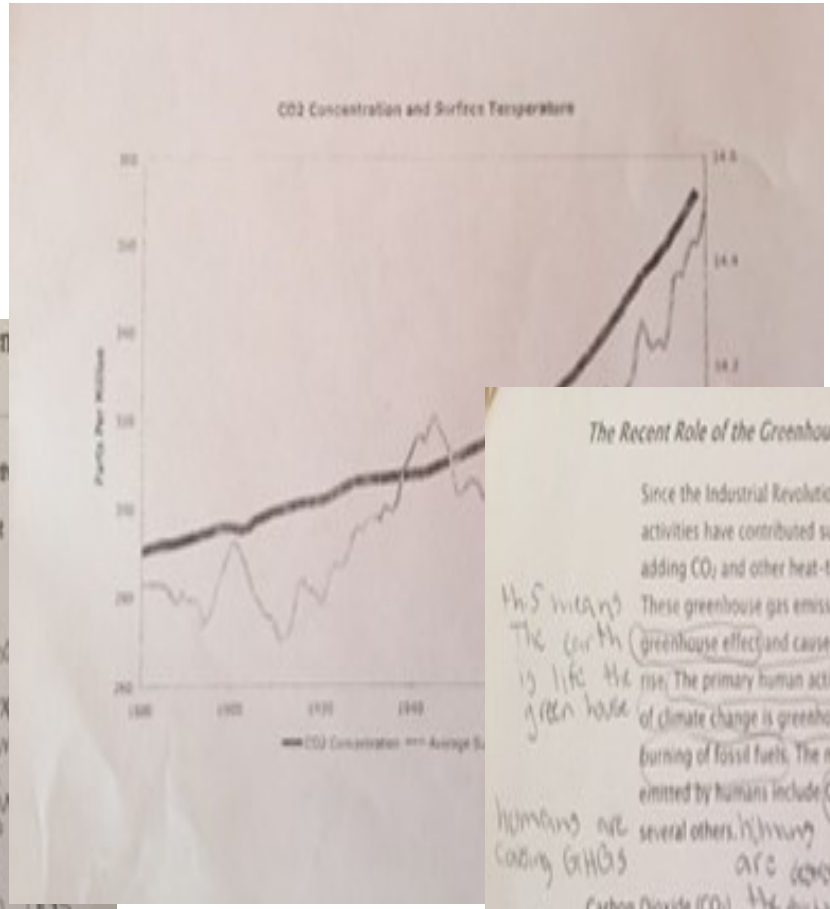
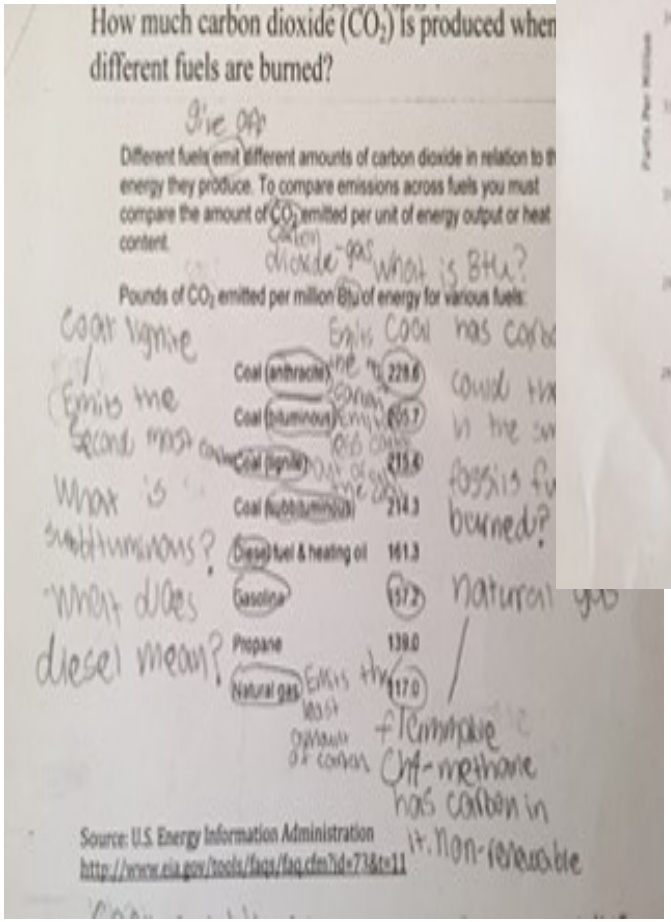
Putting READI Principles Into Practice in the Classroom

- Essential Question
  - Questions that guide unit that trying to get students to explain
- Annotating Text
  - Explicit instruction via teacher modeling and think aloud
- Engaging with Text through discourse
  - Whole class discussion and peer to peer discussion
- Evidence Gathering
- Consensus Model Building throughout unit
- Iterative Cycle
  - Read text, gather evidence, discourse

Text Examples





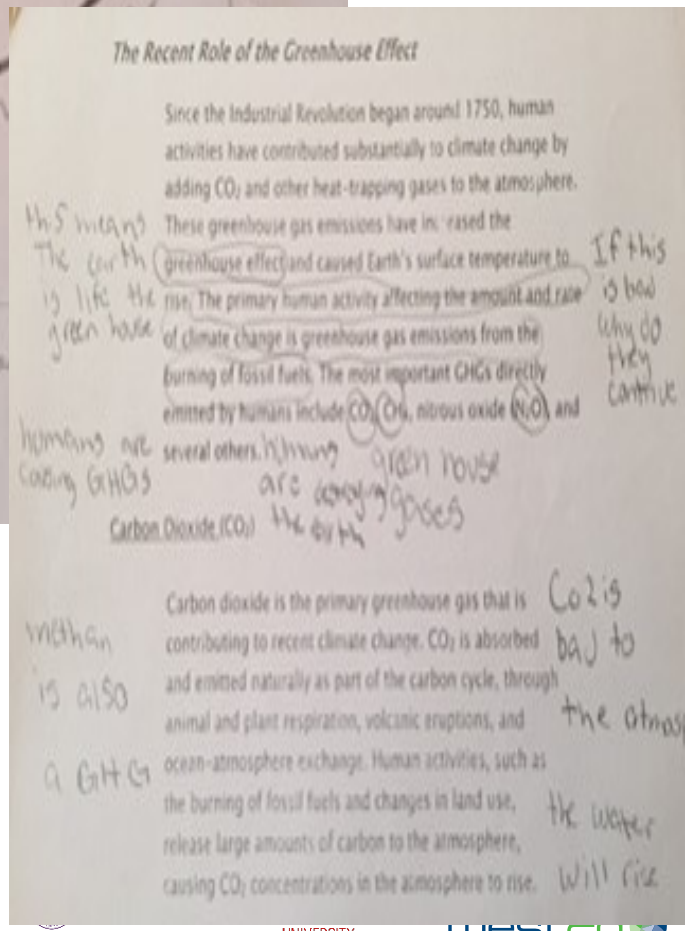
How much carbon dioxide (CO_2) is produced when different fuels are burned?

Different fuels emit different amounts of carbon dioxide in relation to the energy they produce. To compare emissions across fuels you must compare the amount of CO_2 emitted per unit of energy output or heat content.

Pounds of CO_2 emitted per million Btu of energy for various fuels:

Coal (anthracite)	228.6
Coal (bituminous)	205.7
Coal (lignite)	215.4
Coal (subbituminous)	214.3
Diesel fuel & heating oil	161.3
Gasoline	157.2
Propane	139.0
Natural gas	117.0

Source: U.S. Energy Information Administration
http://www.eia.gov/tools/faqs/faq.cfm?id=73&t=11



The Recent Role of the Greenhouse Effect

Since the Industrial Revolution began around 1750, human activities have contributed substantially to climate change by adding CO_2 and other heat-trapping gases to the atmosphere. These greenhouse gas emissions have increased the greenhouse effect and caused Earth's surface temperature to rise. The primary human activity affecting the amount and rate of climate change is greenhouse gas emissions from the burning of fossil fuels. The most important GHGs directly emitted by humans include CO_2, CH_4, nitrous oxide (N_2O) and several others.

Carbon Dioxide (CO_2)

Carbon dioxide is the primary greenhouse gas that is contributing to recent climate change. CO_2 is absorbed and emitted naturally as part of the carbon cycle, through animal and plant respiration, volcanic eruptions, and ocean-atmosphere exchange. Human activities, such as the burning of fossil fuels and changes in land use, release large amounts of carbon to the atmosphere, causing CO_2 concentrations in the atmosphere to rise.

Instructional Tools

Name_____ Investigating Earth Systems: Energy Resourc

Essential Question: "How does human consumption of energy resources affect the Earth?"

Scientists draw on texts, both written and visual models, as well as experiments and existing models, to help them unc the world around them. One important way is to identify evidence in texts, experiments, and models that help them a their inquiry questions.

Below, identify the evidence that helps you better answer the essential question. Then, make interpretations from evi ask yourself what else you need to understand in order to help you address the essential question.

Text	Evidence What was in the text?	Interpretation What did we think about it?	Next Steps What else do we need to
Power Plant Using Fossil Fuels Diagram	The power plant needs fuel.	The fuel is burned to create steam to turn the turbine and generator	Is the smoke and gas com the power plant polluting t

Name _____ Class _____

FOSSILS: WORDS and TERMS to KNOW

When you come across a word in a reading that you do not know, write it down. U context clues in our readings, try to define what the word means in your own word

Word/Term	What I think it means

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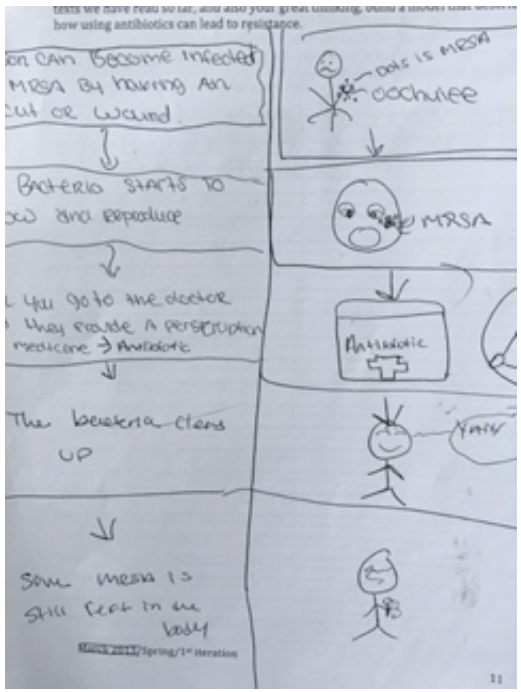
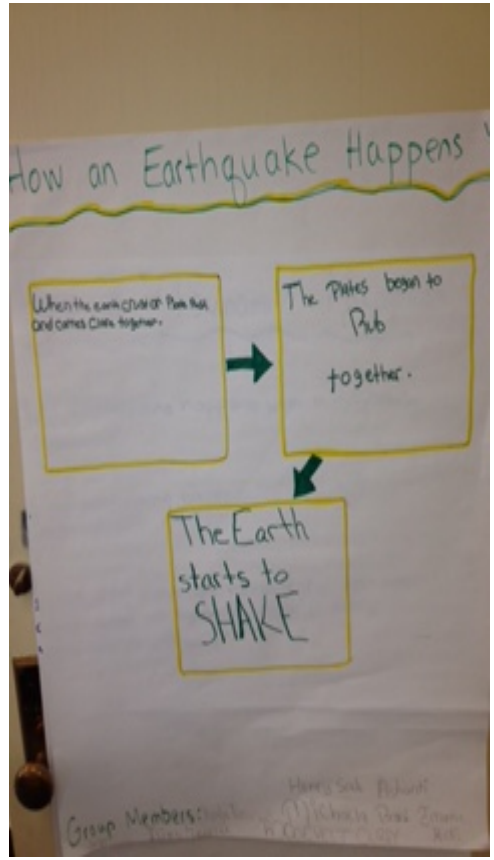
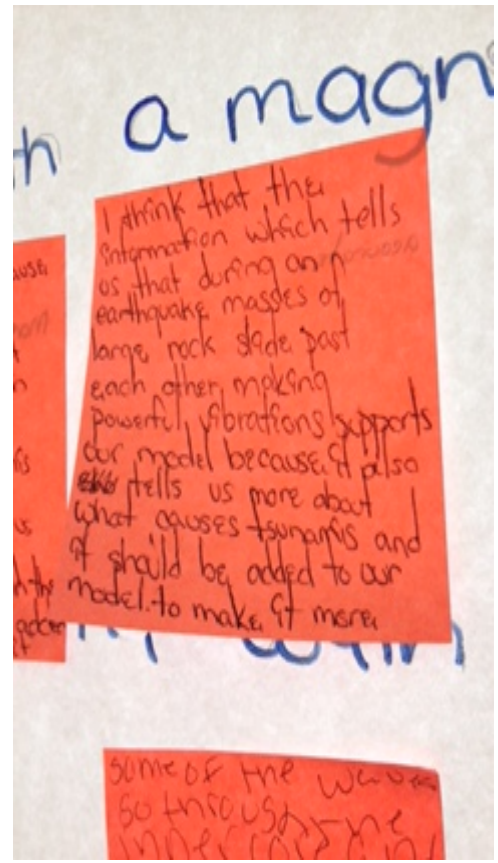
Explanatory Models

- Dynamic Planet Unit (Initial Model and Model Revision)
- MRSA Unit







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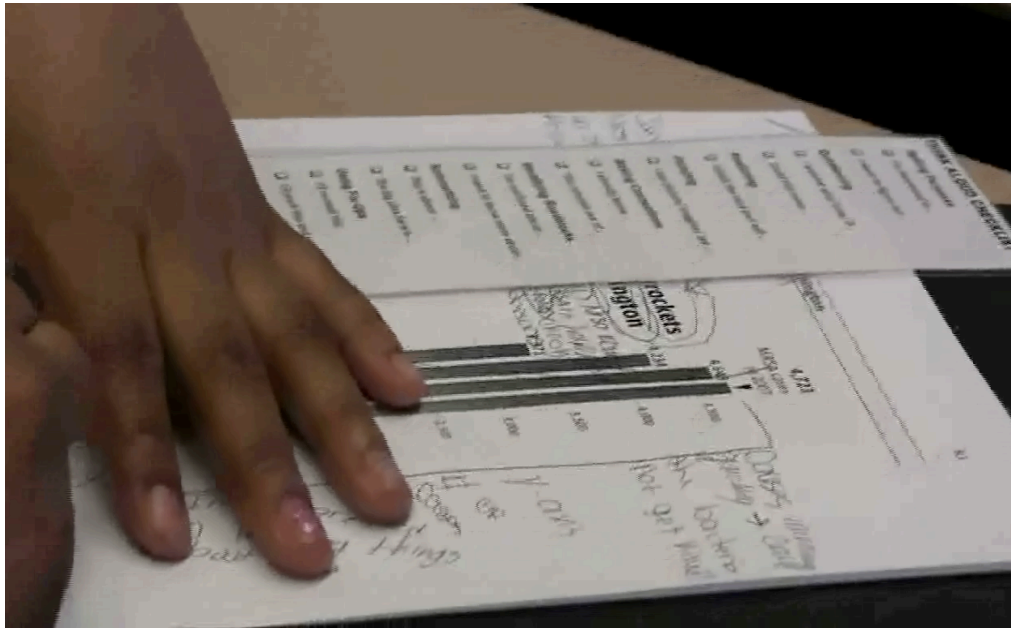
Changes for Students



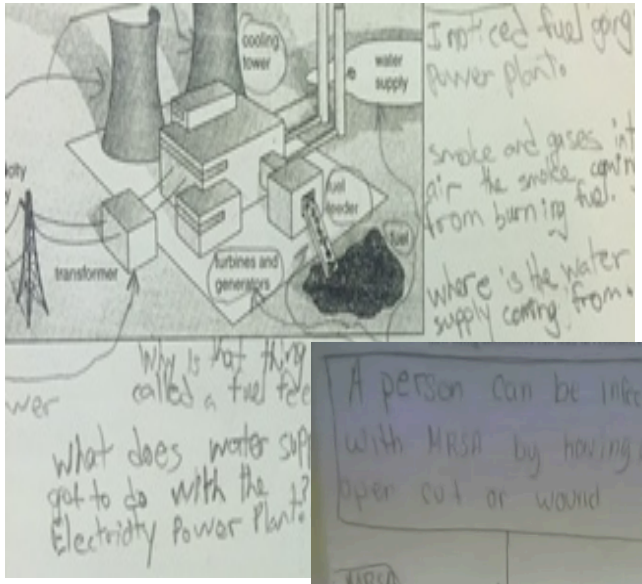
Diagrams, charts, graphs, pictures, informational text

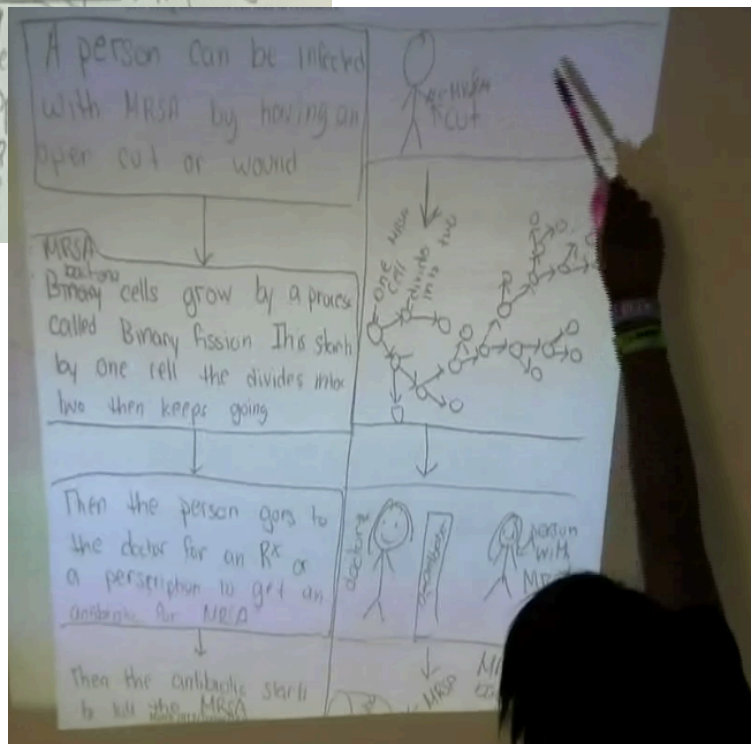
Developed reading skills in science content area

Increased abilities to make meaning of texts and from texts

Constructed meaning of texts and phenomena from repeated opportunities for discourse with teacher, class, and peers

Changes for Students





Used learning from reading the texts to build explanatory model(s) of scientific phenomena

Used text-based evidence to increase understanding by citing evidence, making interpretations, and developing next steps

How did it deepen my instructional practice?

- Depth vs. Breadth
- Release of Teacher as purveyor of knowledge vs. students constructing the knowledge
- Better understanding of student ability to read and comprehend variety of texts (written, graph, chart, diagram)
- Understand student misconceptions from text
- More intentional with what wanted students to focus on from a text
- Increased ability as teacher to get students to actively engage with text and read text