PROJECT READi

Reading, Evidence, and Argumentation in Disciplinary Instruction

Designing at the Crossroads of NGSS and CCSS: Text-Based Investigations for Evidence-Based Argumentation in Science

Cynthia Greenleaf, Willard Brown
Strategic Literacy Initiative, WestEd
Susan Goldman, Mon-Lin Ko
University of Illinois, Chicago

PROJECT READi inquirium Northern Illinois University NORTHWESTERN UNIVERSITY UIC UNIVERSITY OF ILLINOIS AT CHICAGO WestEd

PROJECT READi

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.

PROJECT READi inquirium Northern Illinois University NORTHWESTERN UNIVERSITY UIC UNIVERSITY OF ILLINOIS AT CHICAGO WestEd

READI Science Intervention Design Team

California

- Cynthia Greenleaf
- Will Brown
- Gina Hale
- Ursula Sexton
- Irisa Charney-Sirott
- Jodi Davenport
- California Science Teachers, Adriana Jaureguy, Joanne Zachariades, Carolyn Aguirre, Lisa Childers, Rebecca Sela, Julie Humphrey, Marilyn Stewart

Chicago

- Mon-Lin Ko
- Katie James
- MariAnne George
- Susan Goldman
- Candice Burkett
- Megan Hughes
- Carlos Rodriguez
- Chicago Science Teachers, Mike Fumigalli, Roberta Ingram, Katie McIntyre Rachel Letizia

PROJECT READi inquirium Northern Illinois University NORTHWESTERN UNIVERSITY UIC UNIVERSITY OF ILLINOIS AT CHICAGO WestEd

PROJECT READi

Reading, Evidence, and Argumentation in Disciplinary Instruction

Reading for understanding in science = the capacity to use evidence from multiple information sources to construct, justify, and critique models/explanations of science phenomena

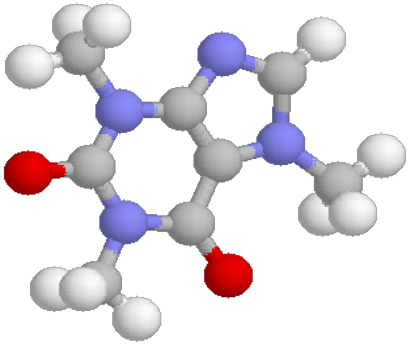
We are working across the adolescent years, grades 6 – 12

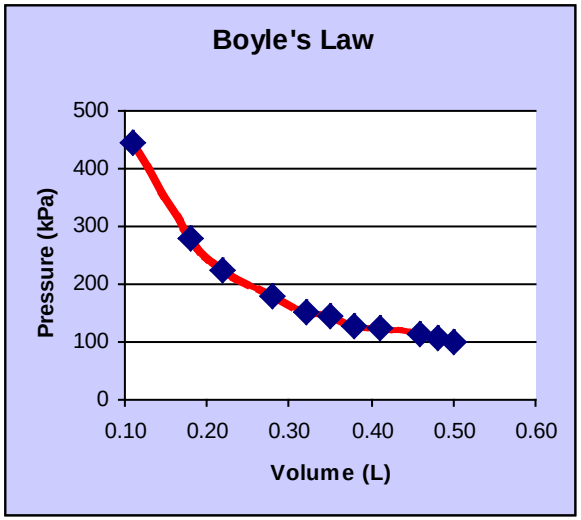
We are designing:

- Text-Based Investigation Modules
- Learning progressions advancing literacy and inquiry practices
- Assessment tools
- Ongoing professional learning for science teachers

Mapping the Literacy and Inquiry Practices of Science

- Reading to Investigate, Explain, Model
  - Attention to evidence, counter evidence
  - Attention to mechanisms, interactions, impacts, scale, magnitude
  - Attention to prior conceptions, science frameworks
  - Interactive argumentation, meaning making
- Multiple forms of text & means of representation
  - Graphs, diagrams, models, exposition
- Valued reasoning processes, stances
  - Skepticism
  - Conceptual change, knowledge development
  - Argument re: best explanation of evidence



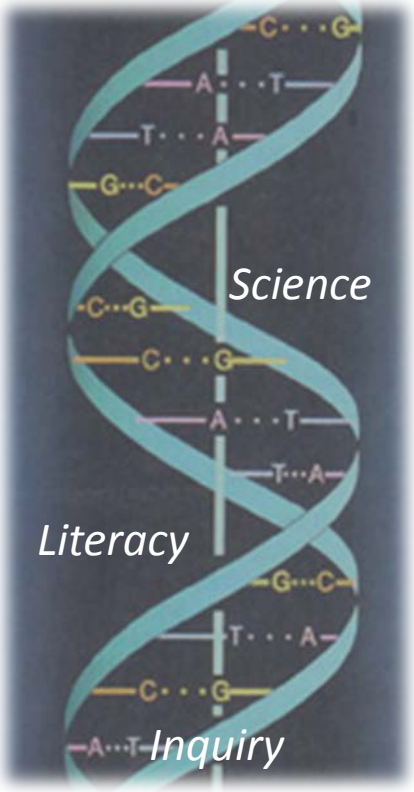


PROJECT READi inquirium Northern Illinois University NORTHWESTERN UNIVERSITY UIC UNIVERSITY OF ILLINOIS AT CHICAGO WestEd

The State of Secondary Science Teaching

- Very little authentic science inquiry occurs (*Taking Science to School, Inside the Classroom, NRC*)
- Little reading for science understanding occurs
- Text resources are limited in scope (overwhelmingly textbook only, for content delivery)
- Students rarely develop and justify their own explanations based on evidence (scientific argumentation)
- Pedagogies (discussion, modeling, collaboration, literacy) necessary to enable [text-based] inquiry largely missing

Engaging in Teaching Literacy as Science Practice is a Major Shift



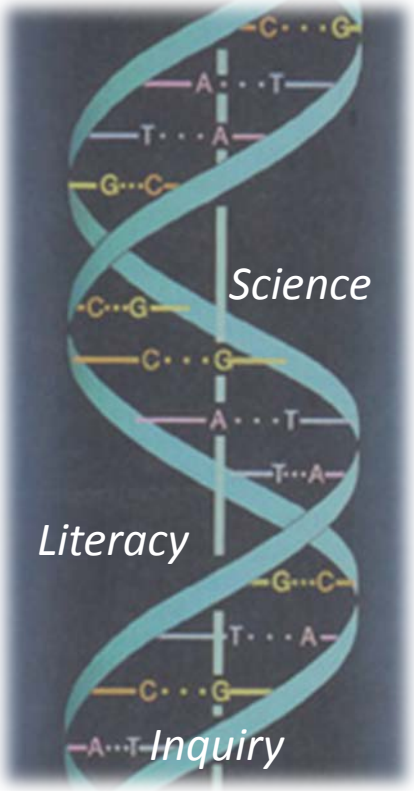
The Challenge

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

PROJECT READi inquirium Northern Illinois University NORTHWESTERN UNIVERSITY UIC UNIVERSITY OF ILLINOIS AT CHICAGO WestEd

Engaging in Teaching Literacy as Science Practice is a Major Shift



The Challenge

To develop science **teachers**':

- Understanding of inquiry practices
- Understanding of literacy practices
- Understanding of texts – varied forms, structures, and challenges
- Pedagogical repertoire

PROJECT READi inquirium Northern Illinois University NORTHWESTERN UNIVERSITY UIC UNIVERSITY OF ILLINOIS AT CHICAGO WestEd

Emerging Misconceptions of CCSS and NGSS

- Assigning ELA teachers to take on literacy in science and technical subjects
- Argumentation units promoting policy debates about science topics rather than science learning
- Treating literacy practices as adjunct rather than fundamental to science practices
- Using science texts solely to deliver science content rather than as catalysts for inquiry

READI Student Learning Goals for Science

1	**Engage in close reading of a range of science representations**; Identify, analyze and interpret scientific evidence in texts/sources including graphs, diagrams, models, exposition
2	S**ynthesize evidence and information across multiple sources** including graphs, diagrams, models, exposition
3	**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
4	
5	
6	**Demonstrate understanding of the epistemology of science** through inquiry dispositions and conceptual change awareness/orientation, seeking "best understandings giving the evidence."

PROJECT READi inquirium Northern Illinois University NORTHWESTERN UNIVERSITY UIC UNIVERSITY OF ILLINOIS AT CHICAGO WestEd

Text-Based Investigation Example: Methicillin-Resistant Staph *Aureus*

- Over the next few weeks, we are going to be studying about a serious public health issue, an infection called MRSA. This infection has been studied by scientists for many years. The bad news is the infection can be deadly. The good news is it is almost entirely preventable IF you understand the science.
- Your job, over the course of this unit, is to make sense of the science, determine the best steps to prevent the spread of the infection, and share what you have learned with your community. Your knowledge may be your community's best defense. Let's get to work!

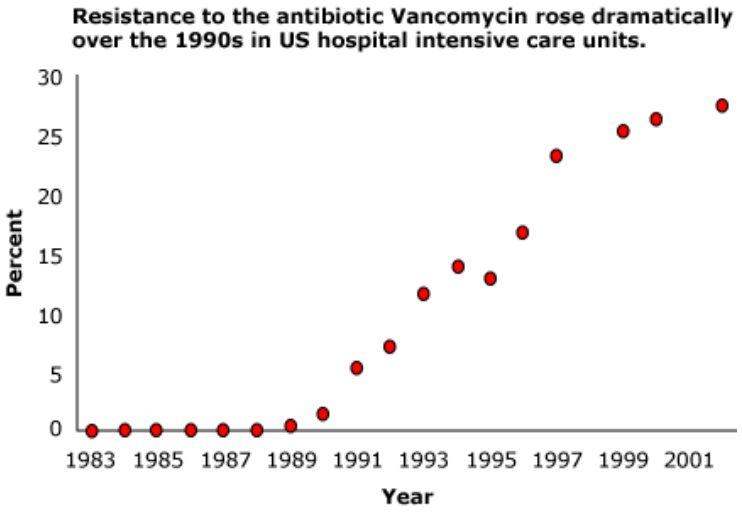
Multiple Opportunities for Explanatory Models and Argumentation

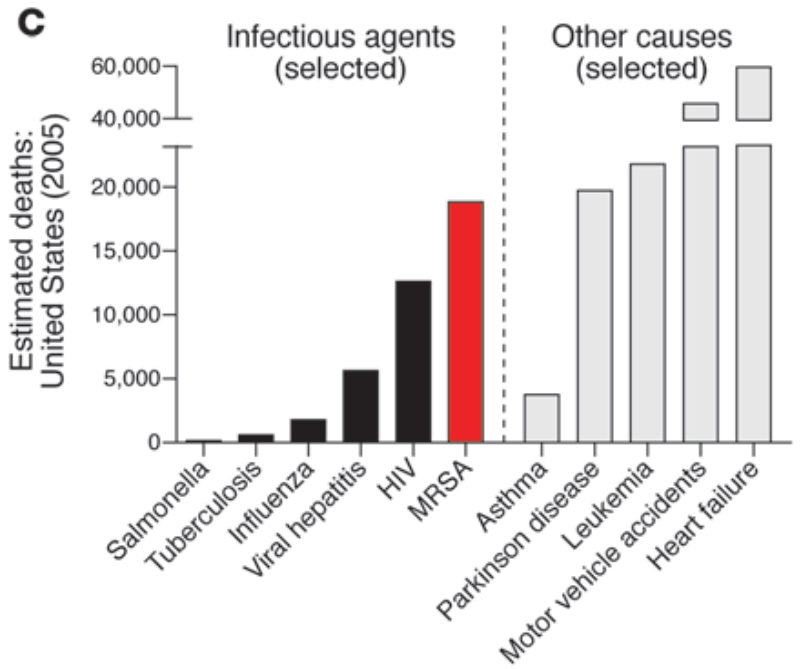
- MRSA Transmission and Infection
- MRSA Spread
- MRSA Evolution
- Managing the Public Health Challenge of MRSA

MRSA Text Set/Sequence

- Connie's Story: A Nurse's Personal Story with MRSA (video) http://webmm.ahrq.gov/perspective.aspx?perspectiveID=58
- 'Superbug' MRSA Worries Doctors, Athletes http://abcnews.go.com/Health/Primetime/story?id=410908&page=1&singlePage=tre
- Kansas City Teen Gets MRSA From Attempted Lip Piercing, Almost Dies http://www.foxnews.com/story/0,2933,354696,00.html#ixzz1m0Zzjt9b
- How long do microbes like bacteria and viruses live on surfaces in the home at normal room temperatures? edited by Bob Silleryhttp://www.popsci.com/scitech/article/2002-08/how-long-do-microbes-bacteria-and-viruses-live-surfaces-home-normal-room-tem
- Antibiotic / Antimicrobial Resistance http://www.cdc.gov/drugresistance/index.html
- Comparison of Estimated Death in U.S. in 2005 http://www.jci.org/articles/view/38226 Frank R. DeLeo, Henry F. Chambers, *J. Clin. Invest.* 2009; 119(9):2464
- MRSA History http://mrsa-research-center.bsd.uchicago.edu/timeline.html http://articles.latimes.com/2006/feb/26/science/sci-staph26/3
- *Contagion* movie trailer
- Superbug, Super-fast Evolution (excerpt) University of California Museum of Paleontology
- Resistance to Vancomycin graph (excerpted) Battling bacterial evolution: The work of Carl Bergstrom. University of California Museum of Paleontology
- Battling Bacterial Evolution: The Work of Carl Bergstrom
- Natural Selection and Antibiotic Resistance (excerpt) Battling bacterial evolution: The work of Carl Bergstrom
- Modification by Natural Selection (excerpt) MODERN BIOLOGY by Holt, page 287
- Growth and Reproduction http://www.biologyreference.com/Ar-Bi/Bacterial-Cell.html#ixzz1RG7ByBLw
- Wash Your Hands. http://www.health.harvard.edu/fhg/updates/update0806d.shtml
- The Success of Evolutionary Engineering Adapted from www.sciencemag.org SCIENCE VOL 293 7 SEPTEMBER 2001
- Microbes and You by David Oliver (excerpt) The Science Creative Quarterly, 8/2003, *Microbes and You,* http://www.scq.ubc.ca/microbes-and-you-normal-flora/

Multiple Representations of Science





Source: http://www.jci.org/articles/view/38226, Frank R. DeLeo, Henry F. Chambers, *J. Clin. Invest.* 2009; **119**(9):2464

PROJECT READi inquirium Northern Illinois University NORTHWESTERN UNIVERSITY UIC UNIVERSITY OF ILLINOIS AT CHICAGO WestEd

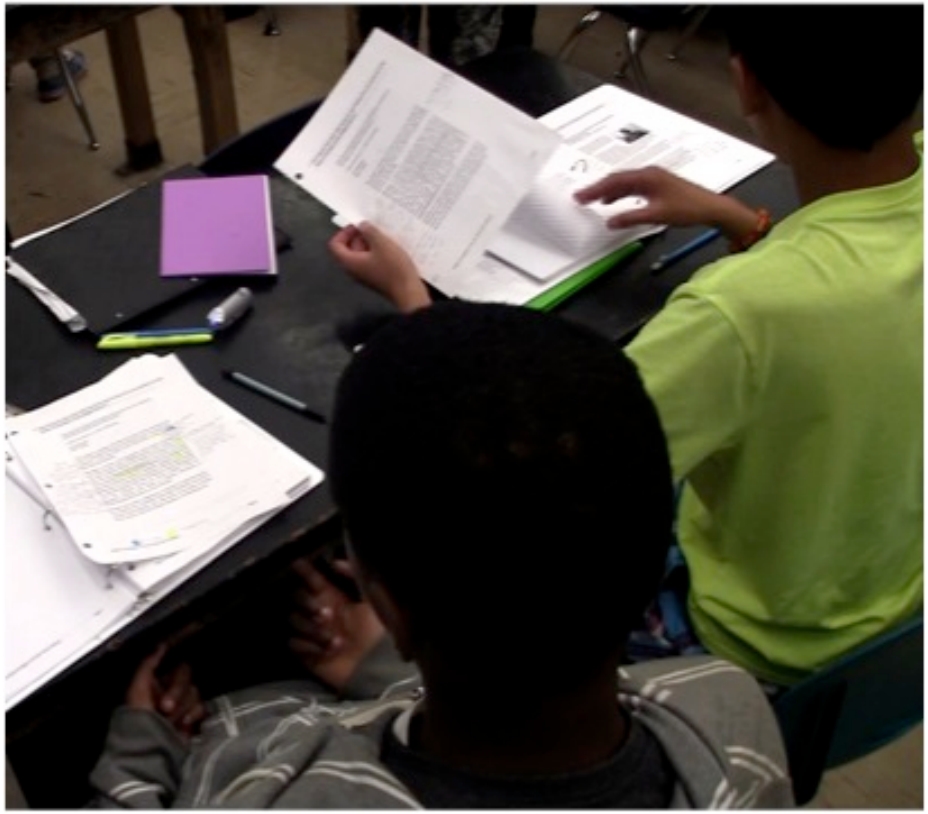
Text Example

Antibiotic/Antimicrobial Resistance

Antibiotics and similar drugs, together called antimicrobial agents, have been used for the last 70 years to treat patients who have infectious diseases. Since the 1940s, these drugs have greatly reduced illness and death from infectious diseases. Antibiotic use has been beneficial and, when prescribed and taken correctly, their value in patient care is enormous. However, these drugs have been used so widely and for so long that the infectious organisms the antibiotics are designed to kill have adapted to them, making the drugs less effective. People infected with antimicrobial-resistant organisms are more likely to have longer, more expensive hospital stays, and may be more likely to die as a result of the infection.

Source: http://www.cdc.gov/drugresistance/index.html

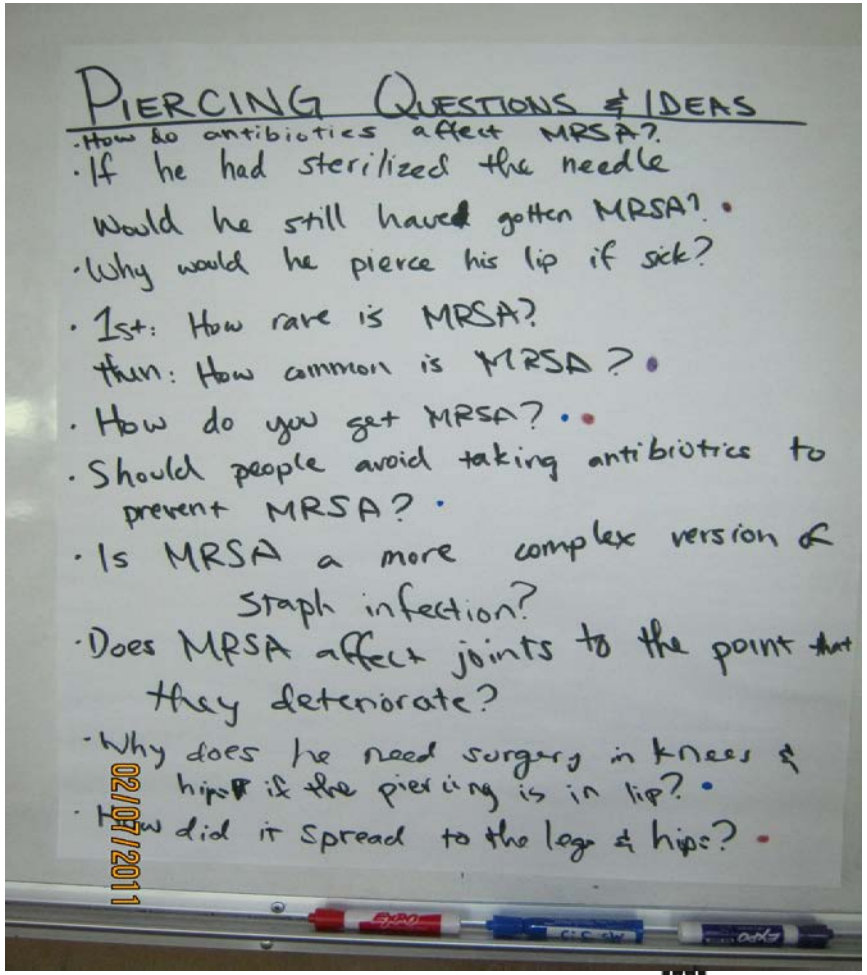
Snapshots of MRSA in MS and HS

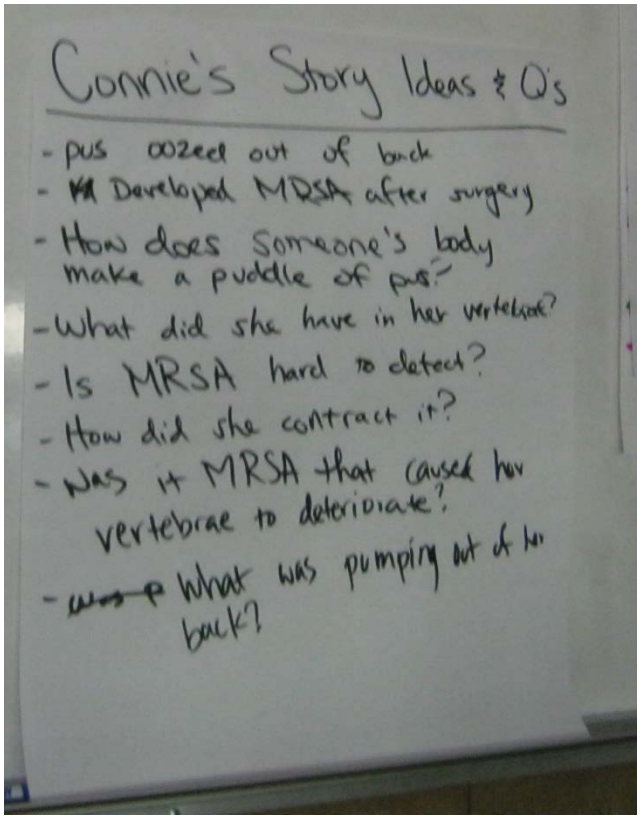


Students engage in close reading of science texts to generate inquiry questions and build knowledge

PROJECT READi inquirium Northern Illinois University NORTHWESTERN UNIVERSITY UIC UNIVERSITY OF ILLINOIS AT CHICAGO WestEd

Students Raise Inquiry Questions to Guide Ongoing Investigation





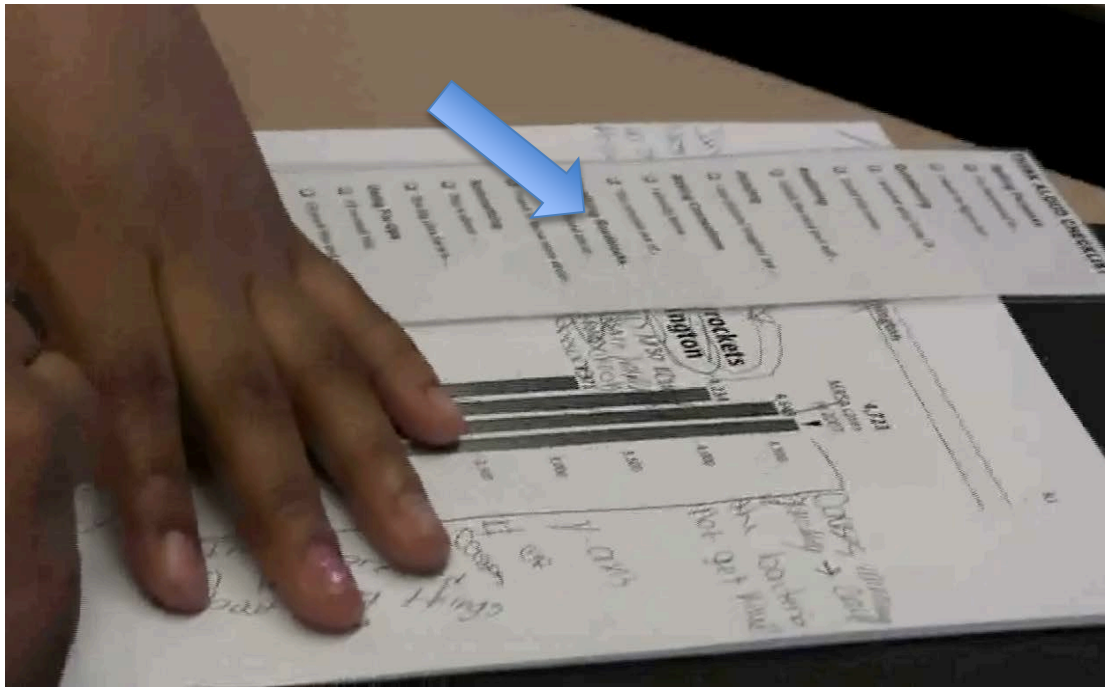
PROJECT READi inquirium Northern Illinois University NORTHWESTERN UNIVERSITY UIC UNIVERSITY OF ILLINOIS AT CHICAGO WestEd

Modeling and Practice of Science Reading Strategies

- Annotation routine

Teacher modeling active reading strategy

Students annotate on their own with reading strategy list introduced earlier



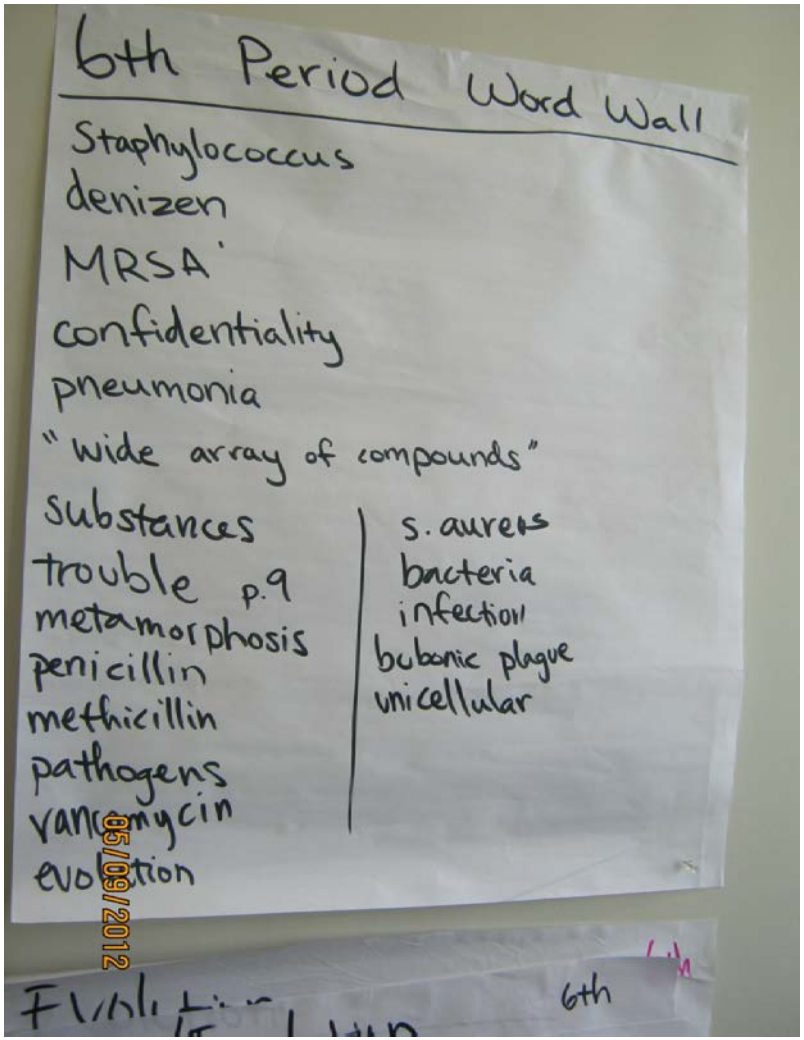
Documenting and Discussing Text Challenges

- Metacognitive Conversation Routines

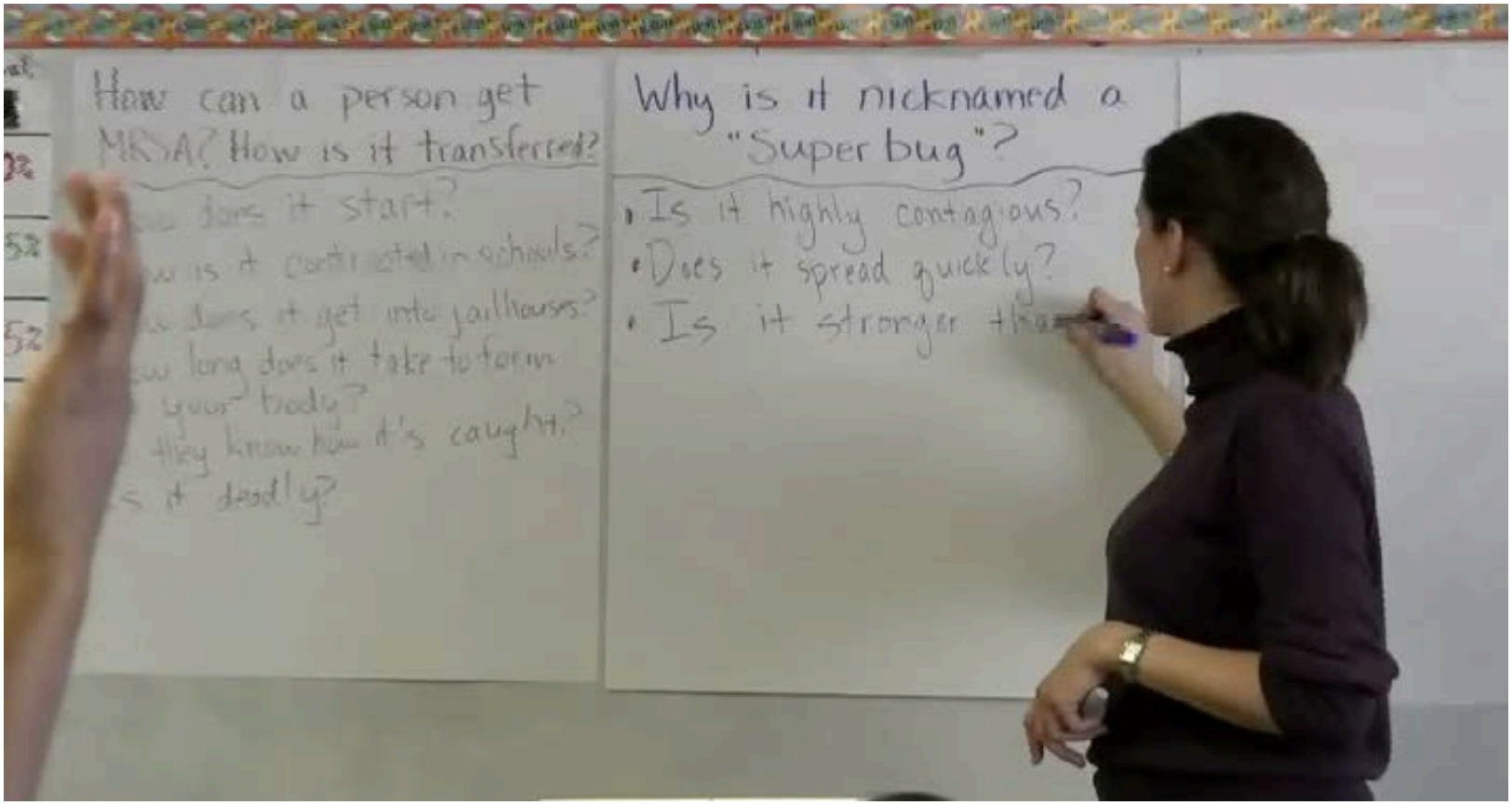
Pair share, class share

Discussion of text challenges

- Sharing confusions
- Identifying challenging vocabulary
- Clarifying
- Sharing approaches for meaning making



Building Knowledge of MRSA Transfer, Spread, and Resistance



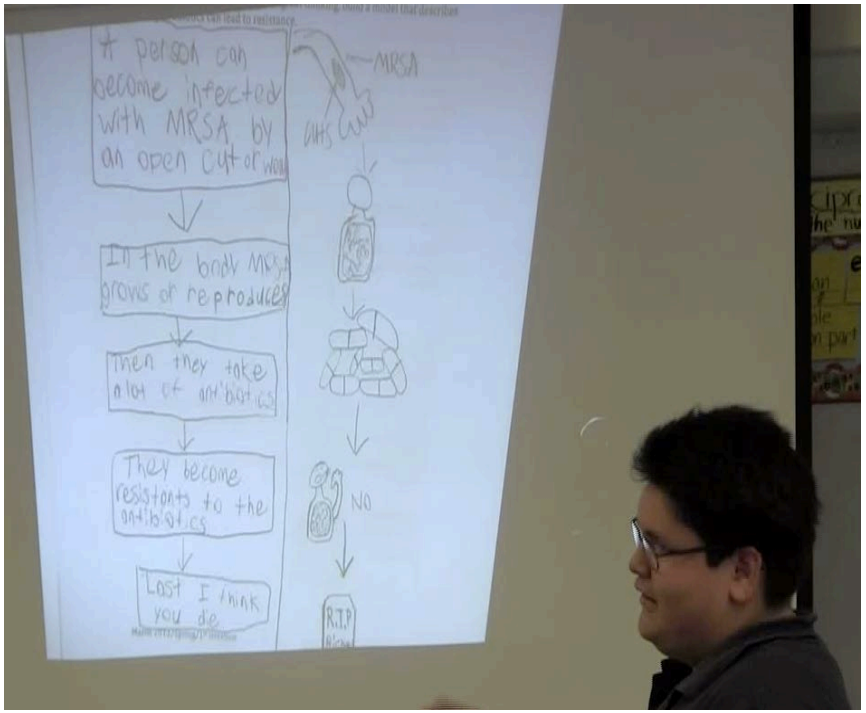
"Is it hard to kill? Is it strong?"
Making connection to prior texts

PROJECT READi inquirium Northern Illinois University NORTHWESTERN UNIVERSITY UIC UNIVERSITY OF ILLINOIS AT CHICAGO WestEd

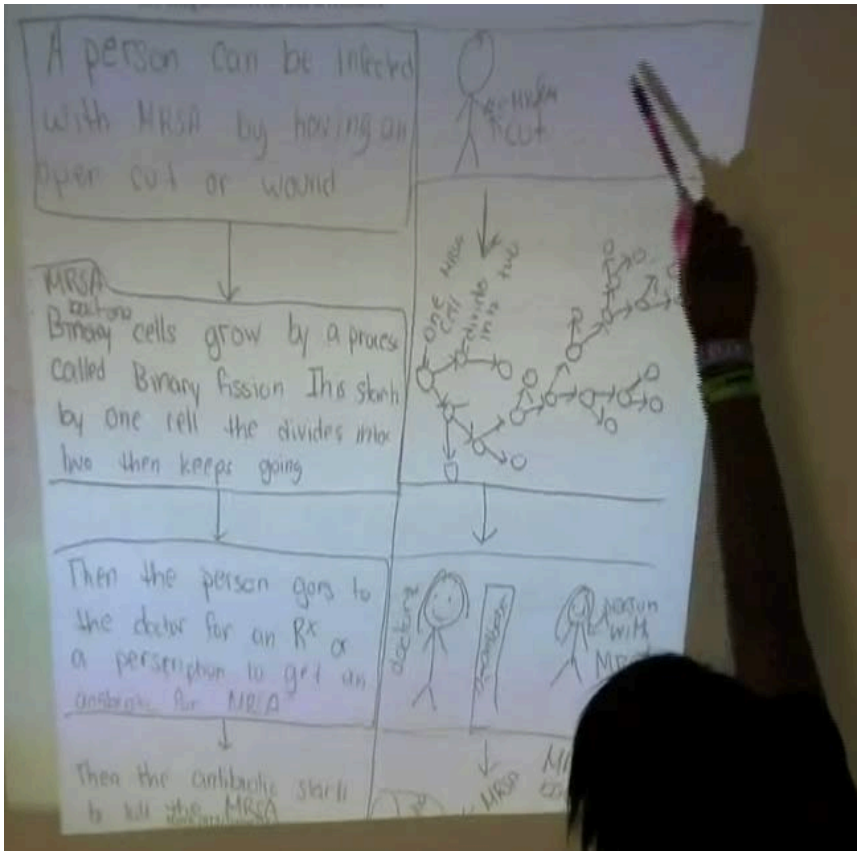
Class Discussion

PROJECT READi inquirium Northern Illinois University NORTHWEST UNIVERSITY PROJECT READi

Constructing Models



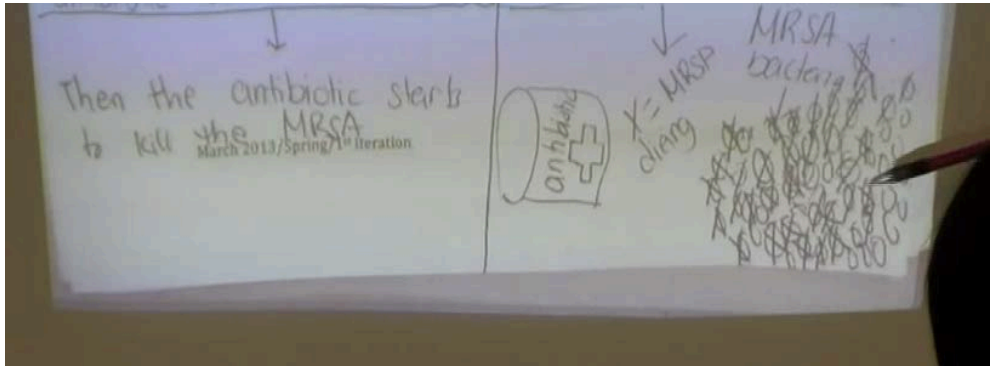
Student 1



Student 2

PROJECT READi inquirium Northern Illinois University NORTHWESTERN UNIVERSITY UIC UNIVERSITY OF ILLINOIS AT CHICAGO WestEd

Discussion of Models Leads to Further Investigation



Bottom portion of Student 2's model

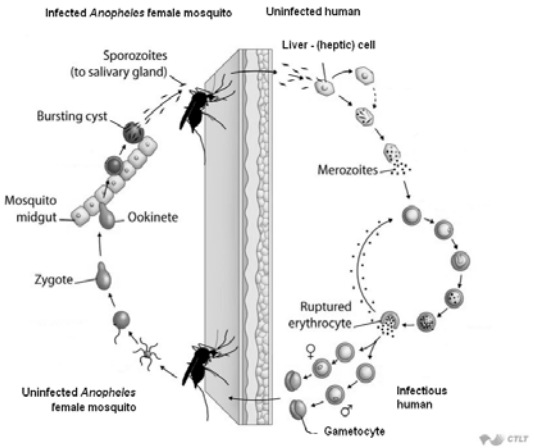
Students explain their models

Other students asked to weigh in

Further questions arise

This spurs continued investigation and sets purpose for reading

Pre-Post Reading and Modeling Task: Malaria



Introduction

Malaria is a serious disease in many parts of the world. It has many "causes" linked in a chain of events. Scientists try to prevent the disease by breaking links in the chain.

Task

Read the texts on the following pages and **make notes in the margins** about your reading, thinking and problem solving processes.

After you have read the texts, respond to the following, using information from your reading:

A. Use the information in the texts to **create a model, using visuals and words, that explains** how malaria could cause millions of deaths each year in Africa. (You may add to the model in text 4, but yours may also look different).

B. Based on what you know now, **explain what might be done at different points to stop the transmission of malaria** and use evidence from your reading to explain why these might work.

What We are Learning – Curriculum Challenges

- Tensions between content "coverage" and time students need to learn to read and interpret texts, to identify and use evidence, and to construct models and explanations.
- Promise as "educative curriculum" both for science teachers and students.
  - True *science inquiry* emerges *with text* as source material for investigations
  - Students learn science content, practices, and how read science texts
  - Teachers learn to turn the work of sense making over to students
  - Students are highly engaged in text-based investigation

What We are Learning – Pedagogical Challenges

- Enabling pedagogies critical but hard to establish
  - Practices not previously present in classrooms began to emerge
  - Interactive notebooks mediate teacher/student interactions & student/text interactions
  - Teacher and students struggle to adopt new practices
- Teachers need time and support to develop these new pedagogies and stances
  - Curriculum materials, however well designed, will not be enough

What We are Learning – Epistemological Challenges

- Students initially treat modeling as school display vs. tentative representation of ideas to be refined based on new evidence
- Teachers initially understand models as representations or surrogates for the real world vs. causal explanations
- Students AND teachers are profoundly inexperienced at using science texts as sources of wonderment, investigation, and inquiry

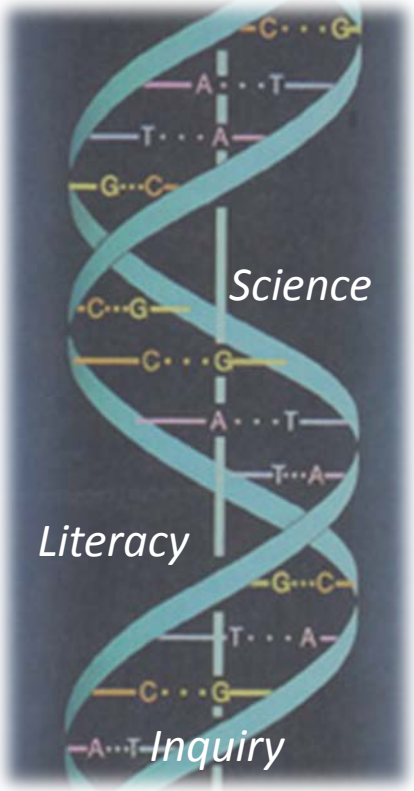
BUT

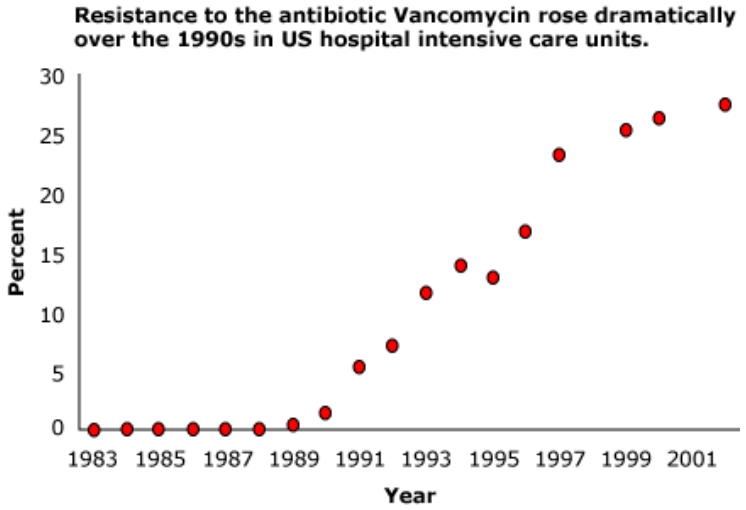
When we engage teachers in doing text-based investigation, inquiring into their own practices as they:

- read and reason with complex science texts,
- synthesize and develop models and explanations across multiple sources, and
- justify and critique their own and their colleagues' models and explanations,

they gain deeper understandings of science inquiry and literacy practices and ways to engage students in these practices.

- Our observations and assessments show students gaining similarly.





The literacy and inquiry practices of science can be authentically and effectively engaged simultaneously in the science classroom, making progress on multiple learning goals and CCSS/NGSS standards at once.

Thank you

PROJECT READi inquirium Northern Illinois University NORTHWESTERN UNIVERSITY UIC UNIVERSITY OF ILLINOIS AT CHICAGO WestEd