PROJECT READi
Reading, Evidence, and Argumentation in Disciplinary Instruction

Reading for Understanding: A Principled Approach to the Integration of Assessment and Instruction for Reading in the Disciplines

Susan R. Goldman and James W. Pellegrino

UIC LEARNING SCIENCES RESEARCH INSTITUTE

PROJECT READi A Multi-Institution Collaboration

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Institute of Education Sciences

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*Classroom teachers who are designing and enacting modules

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Project Context & Rationale

- Importance of reading to learn/acquire information from multiple information sources in academic, professional, and personal life
  - Requires specialized reading, critical thinking, and communicating practices (Alvermann & Moore, 1991; CCSSO, 2010; Goldman & Bisanz, 2002; Lee & Spratley, 2010; Moje, 2008; Moje & O' Brien, 2001; Shanahan & Shanahan, 2008; Snow & Biancarosa, 2003)
- National and international indicators showing that current educational practices are not producing citizens with these skills; ill-prepared for 21st century
- Common Core State Standards in ELA and Literacy in History/ Social Studies, Science and Technical Subjects
  - Specific focus on disciplinary literacies and the engagement with multiple sources of information

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COMMON CORE STATE STANDARDS FOR

English Language Arts
&
Literacy in History/Social Studies, Science, and Technical Subjects

COMMON CORE STATE STANDARDS INITIATIVE
PREPARING AMERICA'S STUDENTS FOR COLLEGE & CAREER

Reading Standards for Literacy in Science and Technical Subjects 6–12

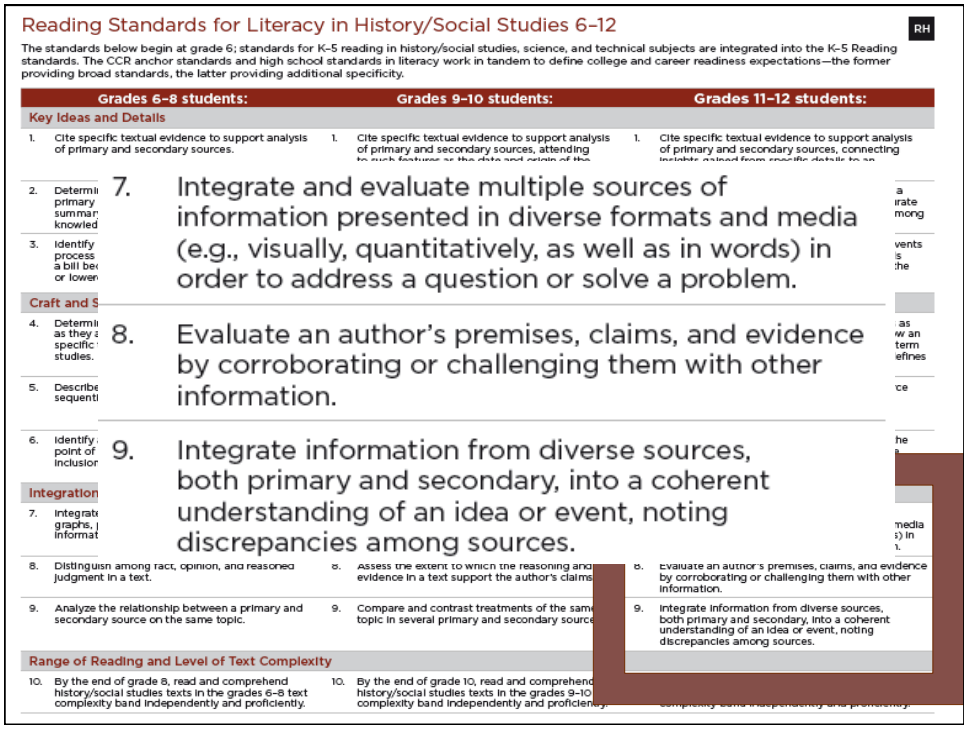
RST

Grades 6–8 students:	Grades 9–10 students:	Grades 11–12 students:
Key Ideas and Details		
1. Cite specific textual evidence to support analysis of science and technical texts.	1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions	1. Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or
2. Determ text; pr distinct		; of a ses, or asing
3. Follow carryin or perf		edure sks; inations
Craft and		
4. Determ and oth they ar context		rms, and as they l context
5. Analyz text, inc to the w		on or strating
6. Analyz explana an expe		an cussing ant
Integratio		
7. Integra express informa diagra		ind media) in blem.
8. Disting based c text.		id verifying or s of
9. Compa from ex multim a text on the same topic.		urces a nomenon, possible.
Range of Reading and Level of Text Complexity		
10. By the end of grade 8, read and comprehend science/technical texts in the grades 6–8 text complexity band independently and proficiently.	10. By the end of grade 10, read and comprehen science/technical texts in the grades 9–10 text complexity band independently and proficiently.	science/technical texts in the grades 11–12 text complexity band independently and proficiently.

7. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

8. Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

9. Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.



Reading Standards for Literacy in History/Social Studies 6–12

RH

The standards below begin at grade 6; standards for K–5 reading in history/social studies, science, and technical subjects are integrated into the K–5 Reading standards. The CCR anchor standards and high school standards in literacy work in tandem to define college and career readiness expectations—the former providing broad standards, the latter providing additional specificity.

Grades 6–8 students:	Grades 9–10 students:	Grades 11–12 students:
Key Ideas and Details		
1. Cite specific textual evidence to support analysis of primary and secondary sources.	1. Cite specific textual evidence to support analysis of primary and secondary sources, attending	1. Cite specific textual evidence to support analysis of primary and secondary sources, connecting
2. Determi primary summar knowled		
3. Identify process a bill be or lower		
Craft and S		
4. Determi as they specific studies.		
5. Describe sequenti		
6. Identify point of inclusior		
Integration		
7. Integrat graphs, informat		
8. Distinguish among fact, opinion, and reasoned judgment in a text.	8. Assess the extent to which the reasoning and evidence in a text support the author's claims	8. Evaluate an author's premises, claims, and evidence by corroborating or challenging them with other information.
9. Analyze the relationship between a primary and secondary source on the same topic.	9. Compare and contrast treatments of the same topic in several primary and secondary source	9. Integrate information from diverse sources, both primary and secondary, into a coherent understanding of an idea or event, noting discrepancies among sources.
Range of Reading and Level of Text Complexity		
10. By the end of grade 8, read and comprehend history/social studies texts in the grades 6–8 text complexity band independently and proficiently.	10. By the end of grade 10, read and comprehend history/social studies texts in the grades 9–10 complexity band independently and proficiently.	

7. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, as well as in words) in order to address a question or solve a problem.

8. Evaluate an author's premises, claims, and evidence by corroborating or challenging them with other information.

9. Integrate information from diverse sources, both primary and secondary, into a coherent understanding of an idea or event, noting discrepancies among sources.

Steps Toward an Integrated System Linking Standards, C-I-A, & PD

- Common Core State Standards are a start but not enough
  - Standards need to be translated using "backwards design" and "evidence-centered design" processes
  - Need to be clear about the **Claims** one wishes to make about students, the **Evidence** that would back up those claims, and the **Tasks** that can provide the critical forms of evidence
  - Need a model for the processes and products of the ***reading for understanding*** process

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Definition: **Reading for Understanding**

- Reading for understanding is the capacity to engage in *Evidence-Based Argumentation (EBA)* drawing on multiple text sources.
  - Unifying framework across disciplines: Making a claim or assertion that is supported by evidence that connects to the claim in a principled way.
  - Respects differences among disciplines: the nature of the claims, what counts as evidence, and what the principles are that warrant information to serve as evidence.

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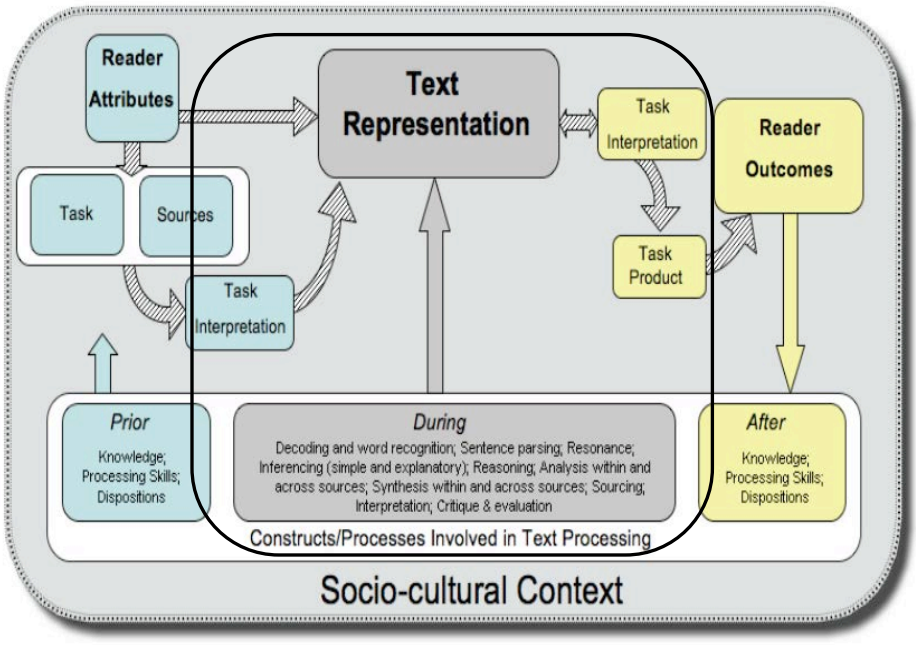
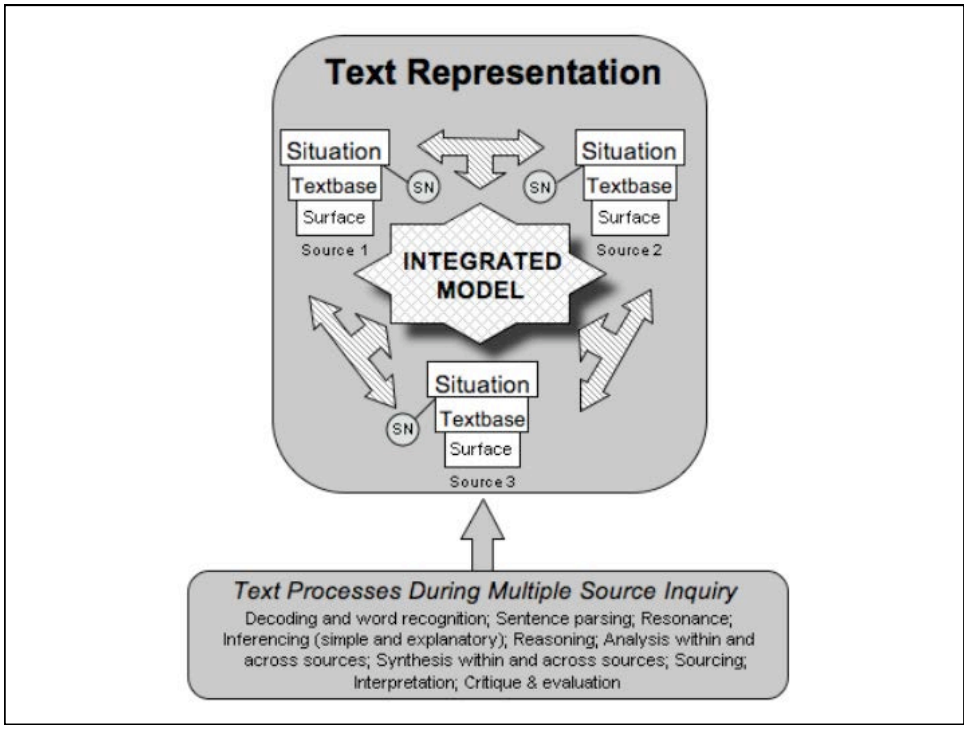


Figure A1. Model of Reading for Understanding



Project's Theory of Action/Change

- Teachers mediate interventions intended to provide opportunities to learn for students.
- Most teachers have not themselves had opportunities to engage in evidence-based argumentation
- READI Intervention development is proceeding at teacher as well as student levels
  - READI Teacher Networks are Professional Learning Communities
    - Teachers engage with texts, tasks, assessments and student work to construct flexible knowledge of the *how* to support students acquisition of capacity to engage evidence-based argument
  - Evidence-based Argument Instructional Modules
    - Mediate the intervention for students
    - Serve as educative curricula for teachers in context of Teacher Networks

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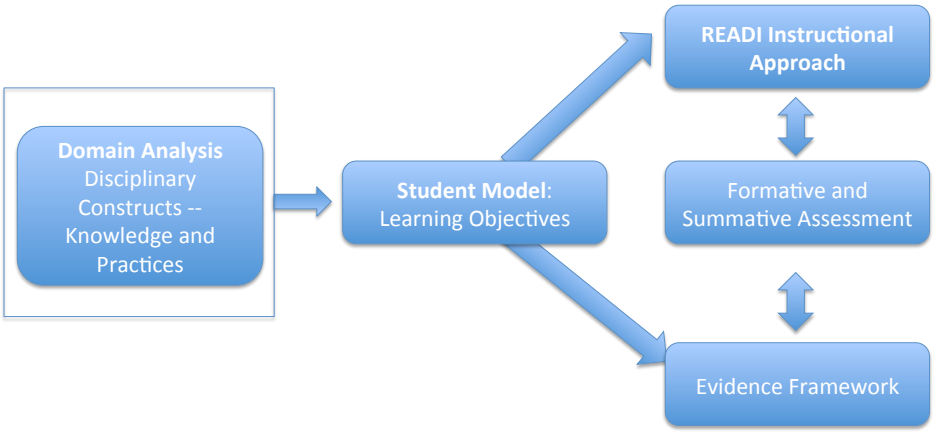
Connecting the Domain Analysis to C-I-A



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Domain Analysis

- Initial Task was to ask what knowledge and practices are involved in evidence-based argumentation in each of the three disciplines we focused on: science, history, literary analysis.
- Multi-disciplinary teams in each discipline generated responses to these based on existing theory and literature
- Looked across the disciplines – five constructs emerged

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Core Constructs: The Foundation

Core Construct	Science	History	Literature
Epistemology			
Inquiry Practices/ Ways of Reasoning			
Overarching Concepts, Themes, Frameworks,			
Information Representation/ Types of Texts			
Discourse/Language Structures			

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Core Construct	Description
Epistemology (What counts as knowledge/ how do we know what we know)	Beliefs, values, and commitments that the reader draws upon to prioritize and warrant claims.

Illustrations/Examples

Science	History	Literature
*Science attempts to build understandings of the physical and designed worlds through models, as *approximations that have limitations.* *Scientific findings: tentative and subject to revision. *Science knowledge is – -- constructed incrementally -- socially constructed *Scientific explanations meet certain criteria (e.g.,based on sound empirical data,parsi-monious,logically cohesive)	*History as -- interpretation (competing narratives) --approximation of the past --perspective taking --claims and evidence --contested and contestable *Historical empathy: inter-preting past actions in context of patterns, beliefs, values existing at the time. *Historical significance (some events/ issues are more significant than others)	Literature provides a terrain for interrogating the meanings of human experiences (e.g. archetypal themes over human history; psychological states; worldviews as propositions about the ideal and the moral, etc.) Literary texts are open to dialogue between and among readers and texts Literary interpretation is about both the meaning of content (i.e. plot, characterization) as well as form

Core Constructs / Knowledge "Buckets"	Description
Inquiry Practices/ Ways of Reasoning	Sci/Hist: Ways in which scientists/historians evaluate claims and evidence in documents Lit: Strategies used by expert readers to construct arguments about the meanings of literary texts

Illustrations/Examples

Science	History	Literature
Scientific knowledge is built by -Developing coherent, logical explanations, models or arguments from evidence -Advancing and challenging explanations -Converging/corroboration of evidence -Comparing/integrating across sources (and representations) -Evaluating sources and evidence	• Sourcing • Contextualization • Corroboration • Questioning Inclusiveness (what perspectives are included or left out) • Questioning Coherence	Infer from details within texts -Plot sequence, causal links; - Motivations & psychological states – - generalizations about how meanings are achieved rhetorically Draw on prior knowledge to interpret social milieu of text, intentionality, moral & philo-sophical precepts Use the text to reflect on the human condition or the reader's life

Core Constructs	Description
Overarching Concepts, Themes, Frameworks,	Sci: Unifying or General Concepts and Themes Hist: Ways in which historians interpret the world ; Lit: Concepts and knowledge on which readers draw as they construct interpretations of literary texts, especially what dimensions of text or readers' beliefs should take center stage in acts of interpretation

Illustrations/Examples

Science	History	Literature
Unifying concepts that apply across scientific sub-disciplines (College Board Standards for College Success (2009) p. 1): *Evolution *Scale *Equilibrium *Matter and energy *Interaction *Form and function *Models and explanations, evidence and representations.	*Categories of historical Study (e.g., Political, Social, Economic, Artistic, etc.) *Basic systems (e.g., feudalism, monarchy) *Relationships among phenomena (e.g., Chance, Chronology, Contingency, Coincidence) *Change over time *Themes: organize content to make it meaningful (e.g., diversity of populations, migration, industrialization)	Moral and philosophical content Archetypal themes Historical contexts of settings and time period when the work was produced Traditions of critical theory Reader Response, Feminist, New Criticism, Black Aesthetic, Post Structuralism, etc. Inter-textuality – valuing relations among literary texts; among literary texts and texts

Core Constructs / Knowledge "Buckets"	Description
Information Representation - Types of Texts	Sci/Hist: Prototypical ways of structuring/ presenting scientific/historical information Lit: Prototypical ways of structuring plots and kinds of prototypical protagonists. Principle guiding the text based on action, character or philosophical or moral thought?

Illustrations/Examples

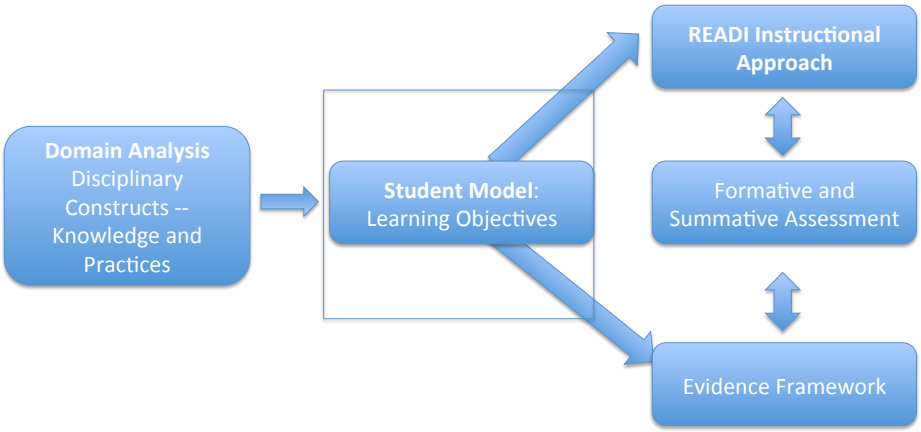
Science	History	Literature
*Text Structures suit purpose: (e.g.,Cause/Effect/Correlation; Problem/Solution/Findings; Sequence/Process) *Multiple Representations (e.g., diagrams,equations, charts,tables,videos,simul.) *Types of Sources/Genres: written for different audiences and purposes; has implications content and structure (e.g, raw data, bench notes, refereed journal articles,	*Structure/Organization of Information w/in Text (e.g., Narrative. Expository, Desc.) *Media – (Traditional Print, Radio, TV, Video, Internet) *Genre (e.g., Memoir, historical fiction, political map, data tables, blogs,etc.) *Sources (e.g., Primary, Secondary sources)	Plot structures (e.g., Coming of age, Science fiction, Fable, Satirical Works, Myth, Magical Realism,Allegory, Tragedy, Romantic Comedy) Character Types (e.g., Detective Trickster Western Hero Epic Hero Tragic Hero Anti Hero Picaresque Hero)

Core Constructs / Knowledge "Buckets"	Description
Discourse/Language Structures	Sci: Prototypical conventions of science texts Hist: Ways of communicating author perspective. Lit: Rhetoric of Literature: How author's selection and sequence of action, dialogue and description create an imaginary world into which the reader is invited through the manipulation of language

Illustrations/Examples

Science	History	Literature
*Science texts contain - distinctive grammatical structures (e.g., nominalizations & passives) - technical and specialized expressions. *Science discourse signals degree of certainty, gnrlizblty, and precision of statements. Argumentation is a scientific discourse practice in which evidence is used to support knowledge claims, and	*Conventions of Chronology *Thematic & topical conventions (political, ideological, social, economic/ feudalism, monarchy, etc.) Conventions of -Where story begins and ends -Presenting Claims and Evidence in oral & written forms (e.g., one-sided, two-sided arguments, multi-sided; refutational arguments) *Word choice as signals of	Imagery to create a visual representation (e.g., description, metaphor, simile) Figuration: lang use to invite a figurative inter beyond literal (symbolism, irony, satire) Problems of point of view: who is speaking, authorial vs. narrative audience; relation of narrator to author pt of view (omniscient, unreliable, mult.) Rhetorical strategies and patterns (parallelism, contrast,

Connecting the Domain Analysis to C-I-A



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Learning Objective: Close Reading

Science	History	Literature
Engage in close reading of a range of science representations; Identify, analyze and interpret scientific evidence in texts/sources including graphs, diagrams, models, exposition	Engage in close reading of historical resources to construct domain knowledge, including primary, secondary, and tertiary sources.	Engage in close reading of literary texts to construct interpretation (s) of human experience based on types of plots, characters, use of language and rhetorical devices.

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Learning Objective: Epistemology

Science	History	Literature
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."	Demonstrate understanding of epistemology of history as inquiry into the past, seeing history as competing interpretations that are contested, incomplete approximations of the past, open to new evidence and new interpretations.	Demonstrate understanding that texts are open dialogues between readers and texts; literary works embody authors' interpretations of some aspect of the human condition; authors make specific choices about language, images, symbols; patterns in language provide clues to messages/ interpretations of literary works.

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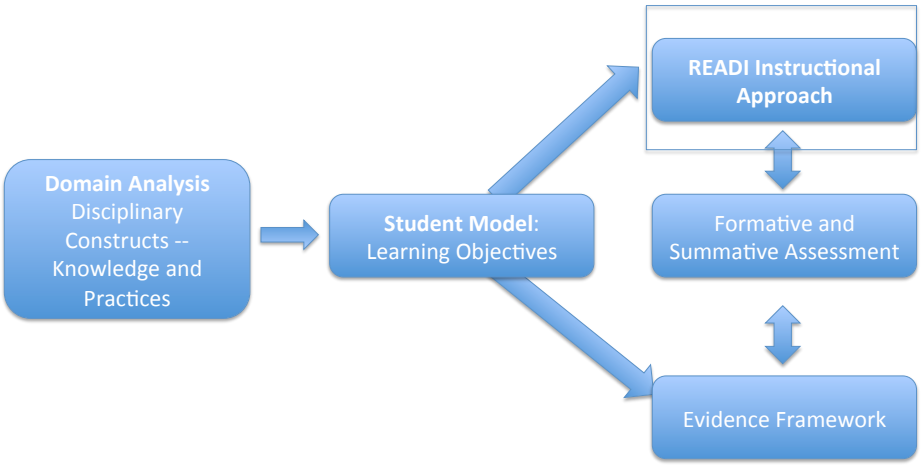

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Intervention via Modules

- INTERVENTION: Major component of Project READi addresses challenges related to
  - Teachers' preparation to teach disciplinary practices as well as content
  - lack of instructional resources to support teaching/learning EBA - materials and assessments, especially formative assessments.
- Create educative, instructional models of EBA
  - Reflect empirical evidence on EBA processes in disciplines
  - Reflect realities of teaching and learning in classrooms.
  - Focus teachers on deep principles that underlie EBAs so that the modules are generative

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Module Core Design Principles

- Tasks
  - Authentic discipline-specific inquiry
  - Draw on multiple texts
  - Developmentally appropriate – learning sequences build requisite knowledge
- Participation structures & classroom discourse routines
  - Maximize student talk and effort
  - Draw on everyday language practices and experiences
  - Model and provide access to close attention to text, academic language, disciplinary discourse, metacognitive awareness
- Instructional tools
- Formative Assessment Support

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Core Design Principles cont' d.

- Instructional Tools provide support and scaffolding for
  - engagement and content knowledge and activation of related experiences,
  - grappling with text,
  - disciplinary discourse frames and academic language
  - feedback on elements of task execution
- Formative assessments
  - make thinking visible in multiple means – oral (formal and informal), written, graphic, text annotations
  - provide feedback loops to guide instruction and goal setting

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Module Architecture: Four Basic Parts

- Learning objectives/goals
  - What do we want students to know and be able to do?
- Tasks
  - What are we asking students to do? Is it aligned with the learning objectives? Is it engaging for students?
- Materials
  - What are the information resources (traditional print, static and dynamic visuals, video, etc.)? How are they sequenced? How do they relate to one another and to the task?
- Instructional supports
  - What are the classroom norms, participation structures, types of activities that support students' learning?

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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	**Synthesize evidence and information across multiple sources** including graphs, diagrams, models, exposition
3 4 5	**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
6	**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 giving the evidence."

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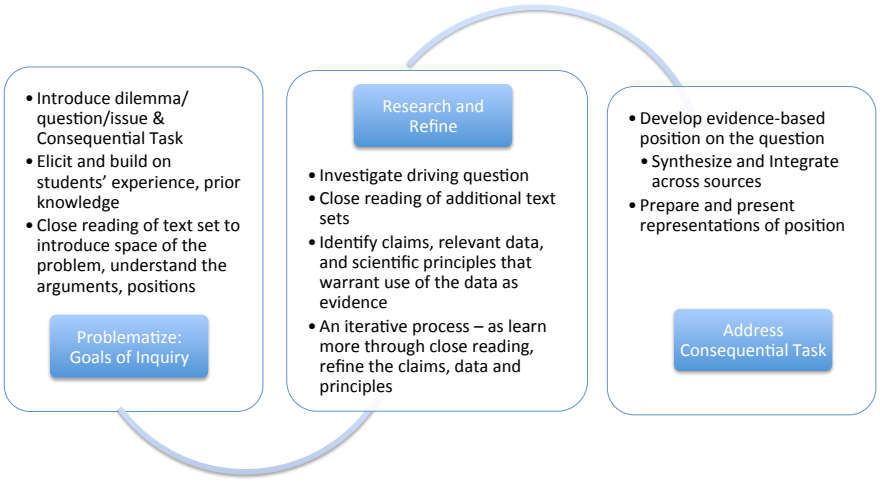
Overview of Evidence-Based Argumentation Module for Science



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Methicillin-Resistant Staph *Aureus* MRSA (AKA Flesh Eating Disease)

- 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!

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Inquiry Questions

- **Significance:** What is the scientific significance and relevance of Methicillin-Resistant Staphylococcus Aureus (MRSA) to me, my family, my community? Why should I or others care about MRSA?
- **Causation:** How is MRSA transmitted? How does MRSA infection occur? What caused MRSA to emerge and increase? Where did MRSA come from?
- **Prevention:** What can limit the risk of MRSA? How do we prevent MRSA from spreading? How do we reduce our own risk?

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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#ixzz1m0Zjt9b
- How long do microbes like bacteria and viruses live on surfaces in the home at normal room temperatures? edited by Bob Sillery http://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/

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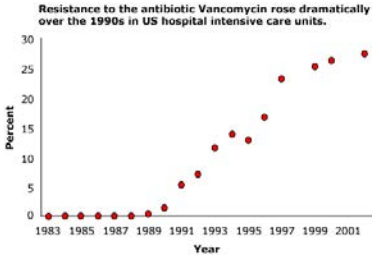
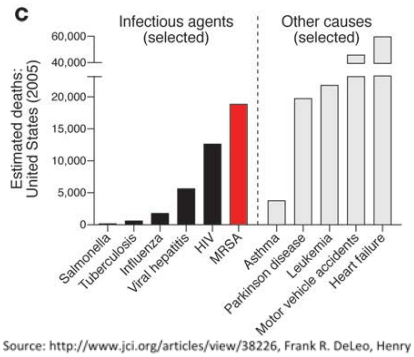
Multiple Representations of Science





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

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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

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Scaffolds and Tools

- Interactive Notebooks
- Gateway and cultural modeling activities
- Text Annotation Routines
- Note taking tools
- Concept/Vocabulary Development routines
- Metacognitive Routines
- Varied participation structures
- Discourse routines

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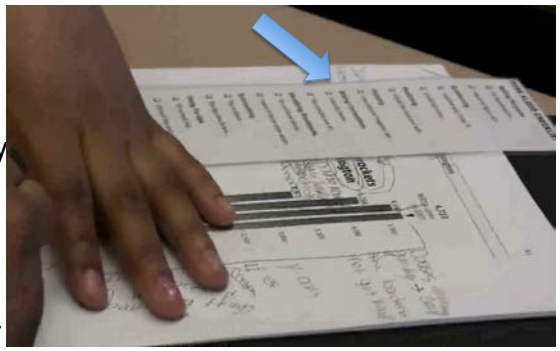
Snapshots of Enactment of MRSA in Sixth Grade

- Annotation
  - *Preceded by Teacher modeling active rdg strategy
  - *Ss annotate on their own with rdg. strategy list introduced earlier
  - *Next step: Share w/ partner, then class



Skyrockets is the 2nd text that Ss work with. It shows exponential growth of cases of MRSA found in Washington state. Connection to math class – rates of change

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Share with Class

Develop questions about MRSA.
Questions guide inquiry – return to throughout the module

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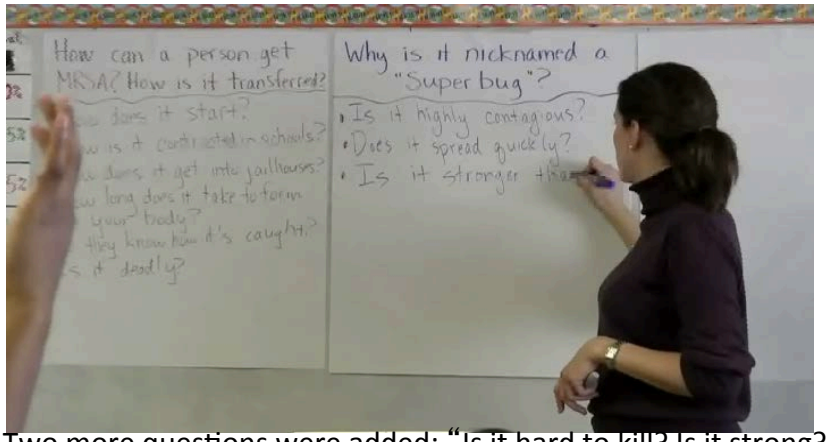
Building knowledge of transfer, spread, and resistance



Two more questions were added: "Is it hard to kill? Is it strong?" These connect back to video viewed earlier that called MRSA a "superbug".

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Day 11: Students create models

- Ss synthesize the information they read in the texts to create a model of how MRSA becomes resistant.
  - The T provided the first "stage" based on consensus from the class that MRSA first begins with a cut or bruise
  - Then asked Ss to "fill out the rest of the steps". Sample of Ss models are below.

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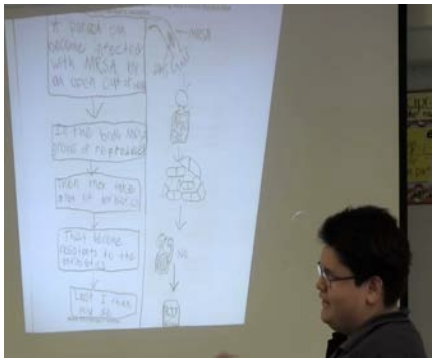
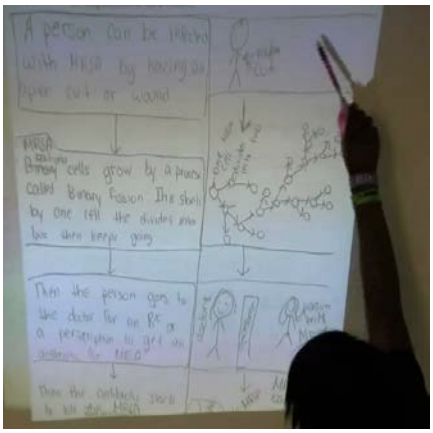
Student Models

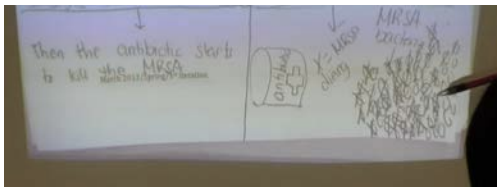


Student 1



Student 2

Discussion of Models leads to further investigation thru reading

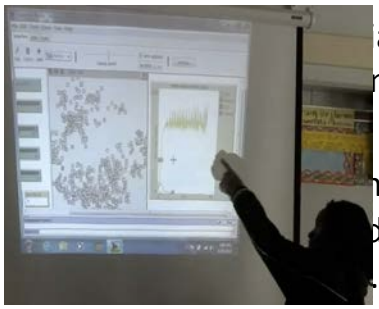


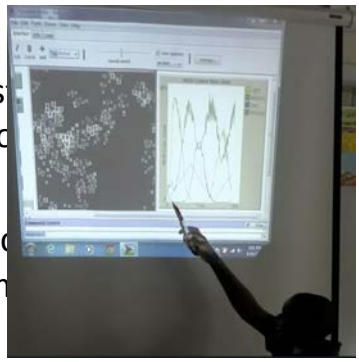
Bottom portion of Student 2's model

T asks student to explain this last part of the model and Student 2 indicates That the antibiotics kill all the bacteria. T asks other students whether they agree with Student 2. Another student says "but we know it doesn't kill off all the bacteria". Discussion continued and after much prompting from T one student says that they know it is resistant but they don't know how it's becoming resistant. This spurs the next phase of investigation and sets purpose for reading texts.

Netlogo Simulation of Peppered Moths

- al s
  nalc
- npac
  diun





– Without pollution

With pollution

– Students Compare how the proportions change within the moth population

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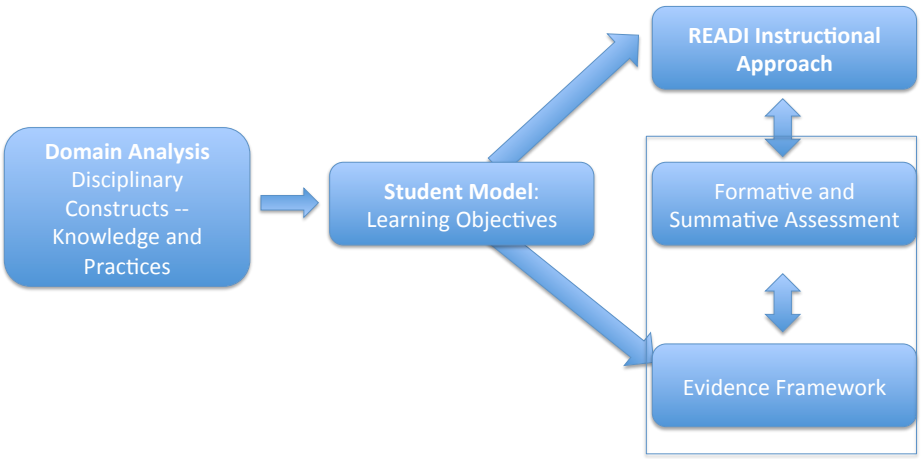
Connecting the Domain Analysis to C-I-A



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Evidence-Based Argumentation: pretest and posttest assessment in Science

- Explanatory causal model of a phenomenon
  - Skin Cancer (or Bleaching of Coral Reefs)
- Text set (5) that provides information students need to construct explanation of phenomenon
  - Adapted versions of authentic texts
  - No contradictory or conflicting information
  - Each text contains information important to building a complete and coherent model
  - Reflects traditional print, diagrams, pictures, graphs or tables
- Inquiry question probed in multiple item formats

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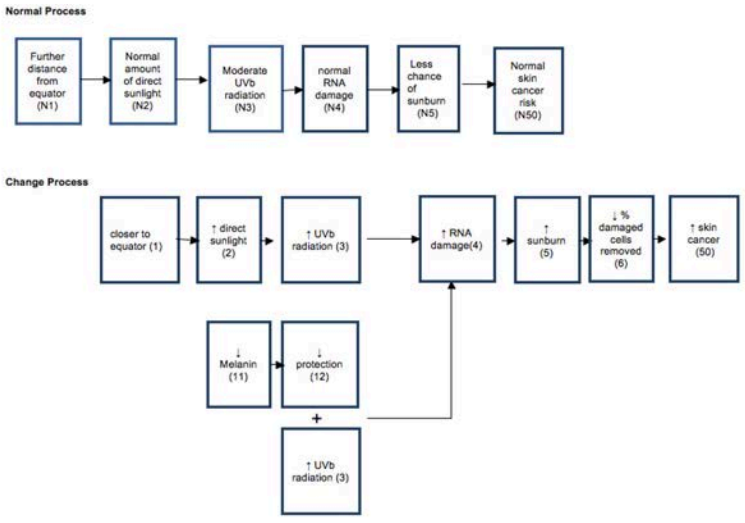
Skin Cancer Explanatory Model



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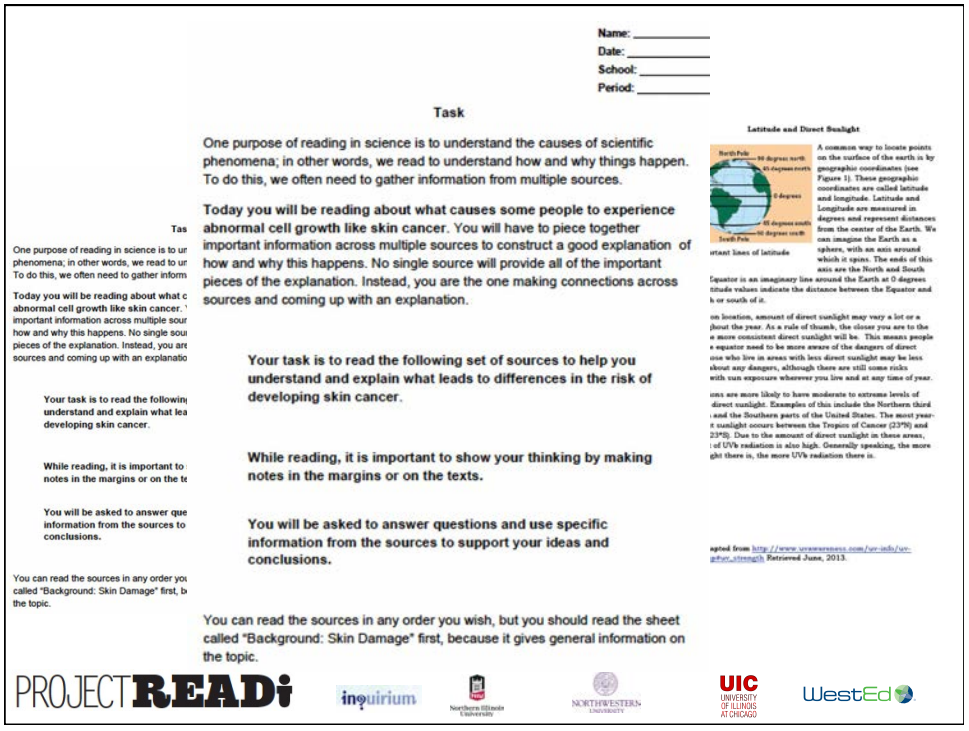

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Date: _____
School: _____
Period: _____

Task

One purpose of reading in science is to understand the causes of scientific phenomena; in other words, we read to understand how and why things happen. To do this, we often need to gather information from multiple sources.

Today you will be reading about what causes some people to experience abnormal cell growth like skin cancer. You will have to piece together important information across multiple sources to construct a good explanation of how and why this happens. No single source will provide all of the important pieces of the explanation. Instead, you are the one making connections across sources and coming up with an explanation.

Your task is to read the following set of sources to help you understand and explain what leads to differences in the risk of developing skin cancer.

While reading, it is important to show your thinking by making notes in the margins or on the texts.

You will be asked to answer questions and use specific information from the sources to support your ideas and conclusions.

You can read the sources in any order you wish, but you should read the sheet called "Background: Skin Damage" first, because it gives general information on the topic.

Latitude and Direct Sunlight

A common way to locate points on the surface of the earth is by geographic coordinates (see Figure 1). These geographic coordinates are called latitude and longitude. Latitude and Longitude are measured in degrees and represent distances from the center of the Earth. We can imagine the Earth as a sphere, with an axis around which it spins. The ends of this axis are the North and South

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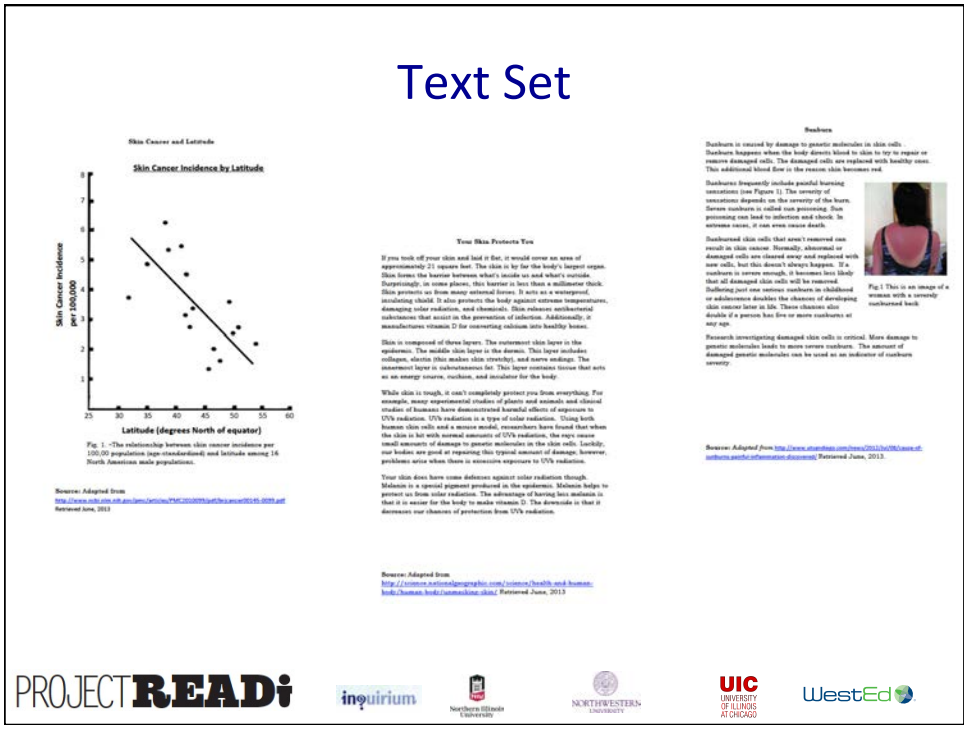

Text Set

Skin Cancer and Latitude

Skin Cancer Incidence by Latitude

Fig. 1 -The relationship between skin cancer incidence per 100,00 population (age-standardized) and latitude among 16 North American male populations.

Source: Adapted from

Your Skin Protects You

If you took off your skin and laid it flat, it would cover an area of approximately 21 square feet. The skin is by far the body's largest organ. Skin forms the barrier between what's inside us and what's outside. Surprisingly, in some places, this barrier is less than a millimeter thick. Skin protects us from many external forces. It acts as a waterproof, insulating shield. It also protects the body against extreme temperatures, damaging solar radiation, and chemicals. Skin releases antibacterial substances that assist in the prevention of infection. Additionally, it manufactures vitamin D for converting calcium into healthy bones.

Skin is composed of three layers. The outermost skin layer is the epidermis. The middle skin layer is the dermis. This layer includes collagen, elastin (this makes skin stretchy), and nerve endings. The innermost layer is subcutaneous fat. This layer contains tissue that acts as an energy source, cushion, and insulator for the body.

While skin is tough, it can't completely protect you from everything. For example, many experimental studies of plants and animals and clinical studies of humans have demonstrated harmful effects of exposure to UVb radiation. UVb radiation is a type of solar radiation. Using both human skin cells and a mouse model, researchers have found that when the skin is hit with normal amounts of UVb radiation, the rays cause (small) amounts of damage to genetic molecules in the skin cells. Luckily, our bodies are good at repairing this typical amount of damage, however, problems arise when there is excessive exposure to UVb radiation.

Your skin does have some defenses against solar radiation through. Melanin is a special pigment produced in the epidermis. Melanin helps to protect us from solar radiation. The advantage of having less melanin is that it is easier for the body to make vitamin D. The downside is that it decreases our chances of protection from UVb radiation.

Source: Adapted from

Sunburn

Sunburn is caused by damage to genetic molecules in skin cells . Sunburn happens when the body directs blood to skin to try to repair or remove damaged cells. The damaged cells are replaced with healthy ones. This additional blood flow is the reason skin becomes red.

Sunburns frequently include painful burning sensations (see Figure 1). The severity of sensations depends on the severity of the burn. Severe sunburn is called sun poisoning. Sun poisoning can lead to infection and shock. In extreme cases, it can even cause death.

Sunburned skin cells that aren't removed can result in skin cancer. Normally, abnormal or damaged cells are cleared away and replaced with new cells, but this doesn't always happen. If a sunburn is severe enough, it becomes less likely that all damaged skin cells will be removed. Suffering just one serious sunburn in childhood or adolescence doubles the chances of developing skin cancer later in life. These chances also double if a person has five or more sunburns at any age.

Fig.1 This is an image of a woman with a severely sunburned back

Research investigating damaged skin cells is critical. More damage to genetic molecules leads to more severe sunburn. The amount of damaged genetic molecules can be used as an indicator of sunburn severity.

Source: Adapted from Retrieved June, 2013.

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Essay Task

Name: _____
Date: _____
School: _____
Period: _____

Writing task

Using this set of documents, write an essay **explaining what leads to differences in the risk of developing skin cancer**. Make sure to connect the ideas within your explanation to the differences in the risk of developing skin cancer. Be sure to use specific information from the documents to support your ideas and conclusions.

_____

_____

_____

_____

_____

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Multiple Choice Items

Name: _____
Date: _____
School: _____
Period: _____

Multiple Choice Items

Based on the documents you read, please select the option that best fills in the blanks to answer the question: **"explain what leads to differences in the risk of developing skin cancer."**

1. People living near 0 degrees latitude experience ____, which leads to more UVb radiation.
   A. decreases in melanin
   B. increases in skin cancer
   C. failure to remove damaged cells
   D. more direct sunlight

2. A more intense sunburn will most likely lead to _____, which causes skin cancer.
   A. decreased UVb radiation protection from the sun
   B. decreased proportion of damaged cells being removed
   C. an increase in melanin production in the skin
   D. increases in direct sunlight exposure

3. Having skin cells that produce very little melanin results in _____, which results in increases in skin cell damage.
   A. increases in UVb radiation exposure
   B. changes in levels of direct sunlight
   C. a decrease in removal of damaged cells
   D. less protection from the sun

4. An increase in UVb radiation exposure causes _____, which leads to a more severe sunburn.
   A. decreased protection from the sun
   B. changes in removal of damaged skin cells
   C. increased skin cell damage
   D. changes in melanin production

5. Using the document titled "Skin Cancer and Latitude," it can be concluded that
   A. more skin cancer occurs the further north you are.
   B. less skin cancer occurs the farther north you are.
   C. rates of skin cancer are the same regardless of distance north.
   D. there is no relationship between skin cancer and latitude.

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Explanation Evaluation

Explanation evaluation task

Below are explanations written by students like you who are explaining **what leads to differences in the risk of developing skin cancer.** Read the explanations and answer the questions that follow.

Explanation 1.

To understand what leads to differences in the risk of developing skin cancer, you have to understand that skin is our largest organ. The skin has many layers to it, so it's not surprising that there are a lot of things that can go wrong with it. Skin cancer is the most feared skin disease. There are several types of skin cancer, and there are different causes. According to the graph, we should avoid being near the equator where there is a lot of direct sunlight. This is because the sun can cause damage, and sometimes the damage is so bad that it increases the risk of skin cancer. Skin cancer rates can also be higher because you have less melanin in your skin. Fortunately, we have all kinds of ways to protect our skin, such as hats, sunscreen, and sunglasses.

Considering the essay question, what did the student do well in the explanation?

Considering the essay question, what advice would you give the student for improving this explanation?

Explanation evaluation task

Another student explanation for **what leads to differences in the risk of developing skin cancer.** Read the explanation and answer the questions that follow.

Explanation 2.

Skin cancer risk can differ depending on how close you are to the equator. The closer you are to the equator, the more direct sunlight exposure you will get. Direct sunlight has more UVb radiation, and this is harmful. If you live further from the equator, you'll experience less direct sunlight, which means less harmful UVb radiation. A lot of UVb radiation can increase the amount of damage to genetic molecules in skin cells causing more severe sunburns. When a sunburn is really bad, it makes it less likely that damaged skin cells will be removed, and this increases the risk of skin cancer. The fewer bad sunburns you have, the less likely it is that you'll have trouble removing damaged skin cells, and this is good.

Considering the essay question, what did the student do well in the explanation?

Considering the essay question, what advice would you give the student for improving this explanation?

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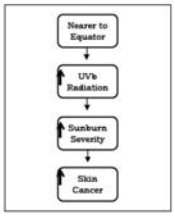
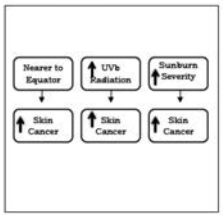
Explanatory Model Evaluation

Graphical model comparison

Model 1



Model 2



Above you can see two graphic models. The arrows between the boxes indicate connections between steps in the process. The arrows within the boxes indicate increases and decreases in components of the process. Which graphic model above provides the best explanation for **what leads to differences in the risk of developing skin cancer?**

Circle your answer: Model 1 or Model 2

Why do you think the model you selected is better? _____

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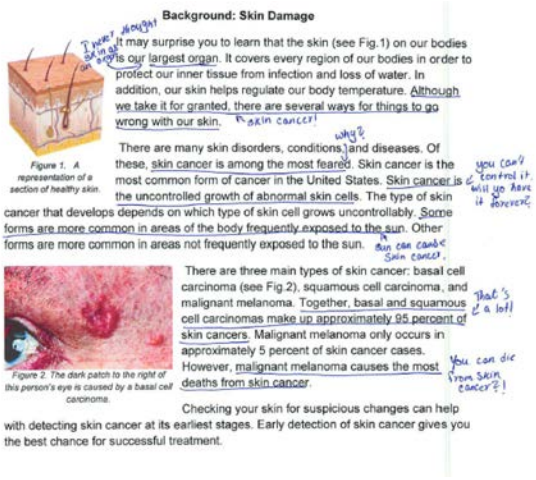
Example of Annotated Text
Skin Cancer



Background: Skin Damage

It may surprise you to learn that the skin (see Fig.1) on our bodies is our largest organ. It covers every region of our bodies in order to protect our inner tissue from infection and loss of water. In addition, our skin helps regulate our body temperature. Although we take it for granted, there are several ways for things to go wrong with our skin.

Figure 1. A representation of a section of healthy skin.

There are many skin disorders, conditions, and diseases. Of these, skin cancer is among the most feared. Skin cancer is the most common form of cancer in the United States. Skin cancer is the uncontrolled growth of abnormal skin cells. The type of skin cancer that develops depends on which type of skin cell grows uncontrollably. Some forms are more common in areas of the body frequently exposed to the sun. Other forms are more common in areas not frequently exposed to the sun.

Figure 2. The dark patch to the right of this person's eye is caused by a basal cell carcinoma.

There are three main types of skin cancer: basal cell carcinoma (see Fig.2), squamous cell carcinoma, and malignant melanoma. Together, basal and squamous cell carcinomas make up approximately 95 percent of skin cancers. Malignant melanoma only occurs in approximately 5 percent of skin cancer cases. However, malignant melanoma causes the most deaths from skin cancer.

Checking your skin for suspicious changes can help with detecting skin cancer at its earliest stages. Early detection of skin cancer gives you the best chance for successful treatment.

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Project's Theory of Action/Change: Status

- READI Intervention implementation is proceeding at teacher as well as student levels – **RCT in 9th grade Science**
  - READI Teacher Networks are Professional Learning Communities
    - Teachers engage with texts, tasks, assessments and student work to construct flexible knowledge of the *how* to support students acquisition of capacity to engage evidence-based argument
  - Evidence-based Argument Instructional Modules
    - Mediate the intervention for students
    - Serve as educative curricula for teachers in context of Teacher Networks
- The development and testing of instructional and assessment materials continues in all three disciplines

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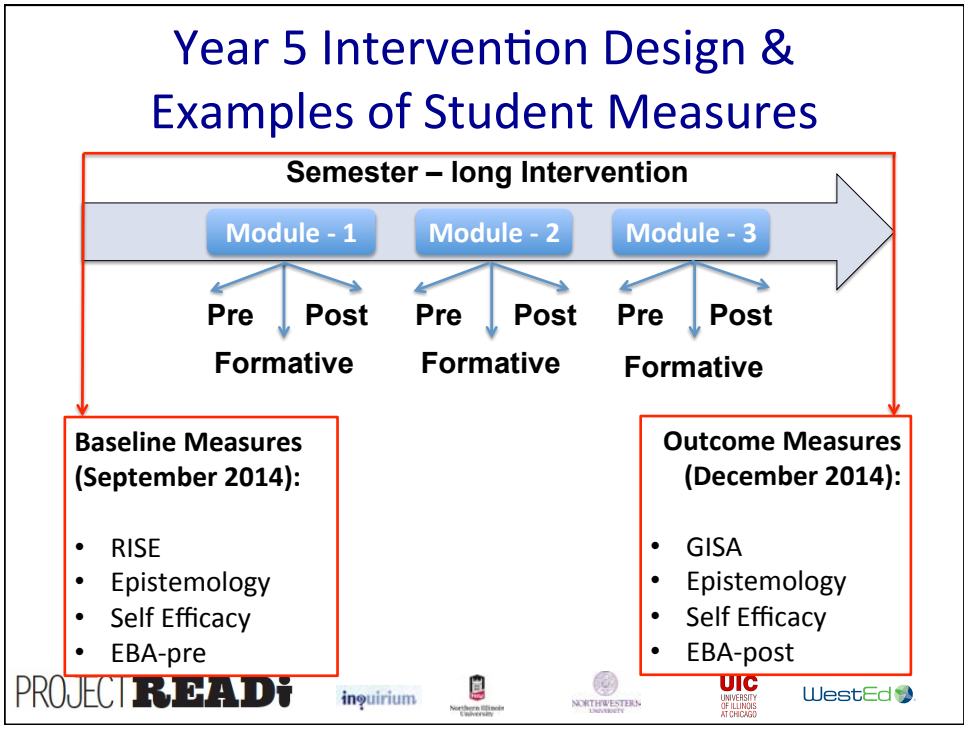
Year 5 Intervention Design & Examples of Student Measures
Semester – long Intervention
Module - 1
Module - 2
Module - 3
Pre
Post
Formative
Pre
Post
Formative
Pre
Post
Formative
Baseline Measures (September 2014):
RISE
Epistemology
Self Efficacy
EBA-pre
Outcome Measures (December 2014):
GISA
Epistemology
Self Efficacy
EBA-post
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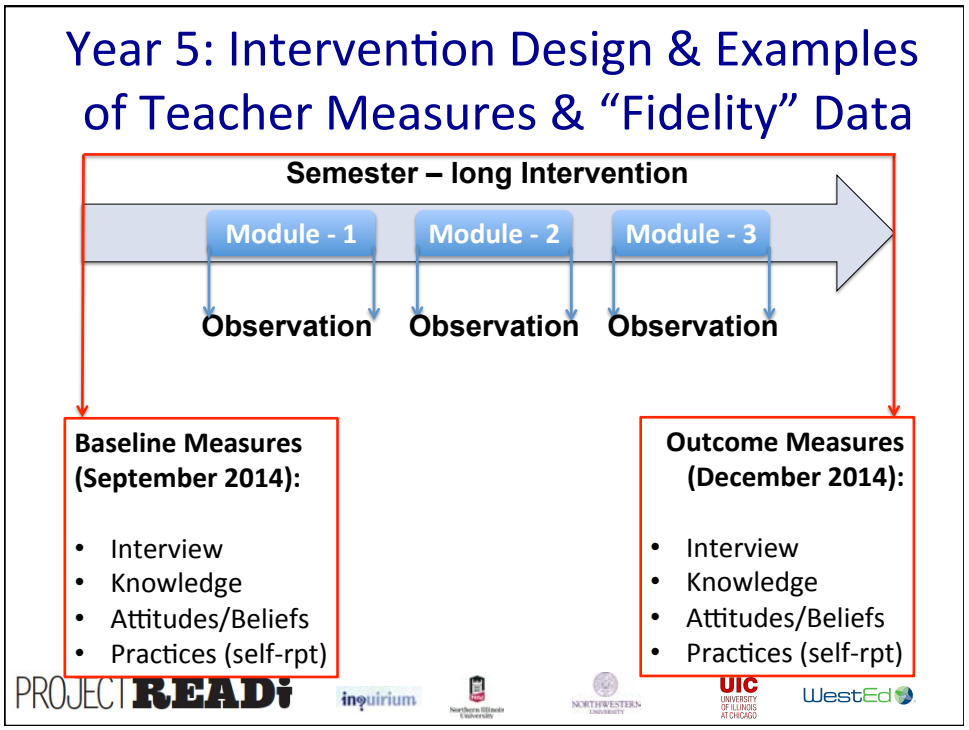
Year 5: Intervention Design & Examples of Teacher Measures & "Fidelity" Data
Semester – long Intervention
Module - 1
Module - 2
Module - 3
Observation
Observation
Observation
Baseline Measures (September 2014):
Interview
Knowledge
Attitudes/Beliefs
Practices (self-rpt)
Outcome Measures (December 2014):
Interview
Knowledge
Attitudes/Beliefs
Practices (self-rpt)
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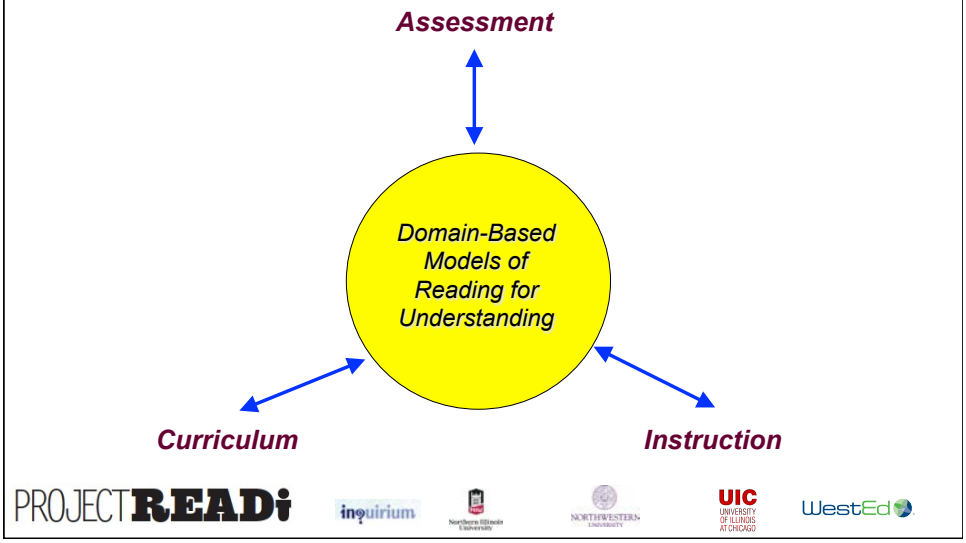
Domain-Based Models as Central Elements in Integrating C-I-A



Questions & Comments