Connecting Literacy and Science with *NGSS* and Common Core

Breakout A: Reading Science

Presented by: Cynthia Greenleaf

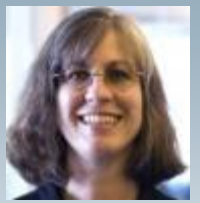
August 6, 2014

11:25 a.m. ET / 10:25 a.m. CT / 9:25 a.m. MT / 8:25 a.m. PT

Introducing today's presenter…

Cynthia Greenleaf
WestEd

Engaging Reading as an Inquiry Practice of Science



Cynthia Greenleaf

Strategic Literacy Initiative

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www.readingapprenticeship.org

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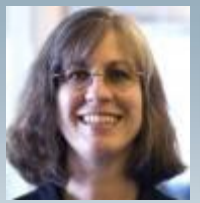
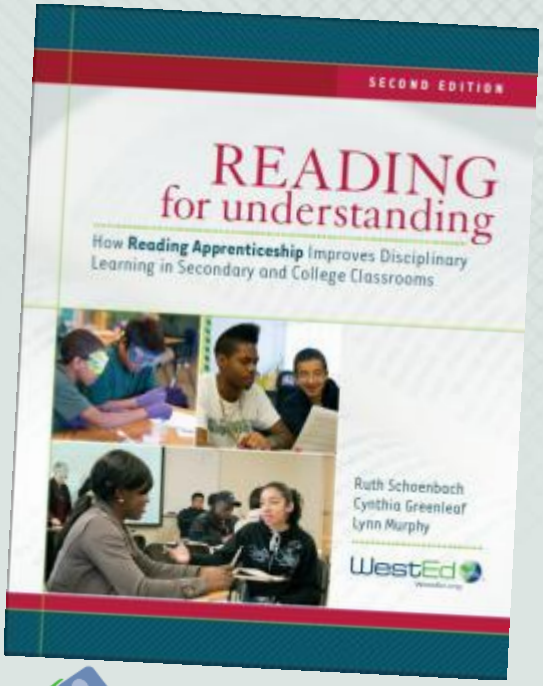
Strategic Literacy Initiative (SLI) Program of Research and Development





- Reading Apprenticeship Instructional Framework
- Inquiry-based designs for teacher professional development
- R&D in discipline-specific literacy instruction

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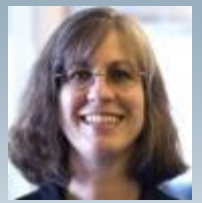
Current Work and Studies



- RAISE (i3 Validation Grant – high school ELA, history, science
- iRAISE (i3 Development Grant – on-line high school science professional development)
- READI (Reading for Understanding Grant – middle and high school ELA, history, science)
- Reading Apprenticeship in Community College STEM
- Reading Apprenticeship Writing Connections (SEED)
- Site-based Professional Development

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Agenda: To Share Compelling Reasons to Read in Science Classes, and Science-Supportive Ways to Do So

- New standards offer an *unprecedented* opportunity to integrate literacy and science inquiry practices
- You know how; your students don't (but need to)
- Science texts are cool and varied, just like science
- Science texts serve important roles for scientists (and for science learners)
- Inquiry and meaning making practices are similar for both reading and science learning
- Teaching approaches to support science and reading overlap
- We can make reading science texts more like doing science
- Good models of "science inquiry with texts" point the way
- Resources abound

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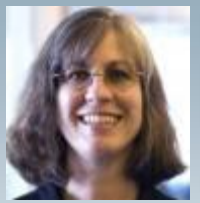
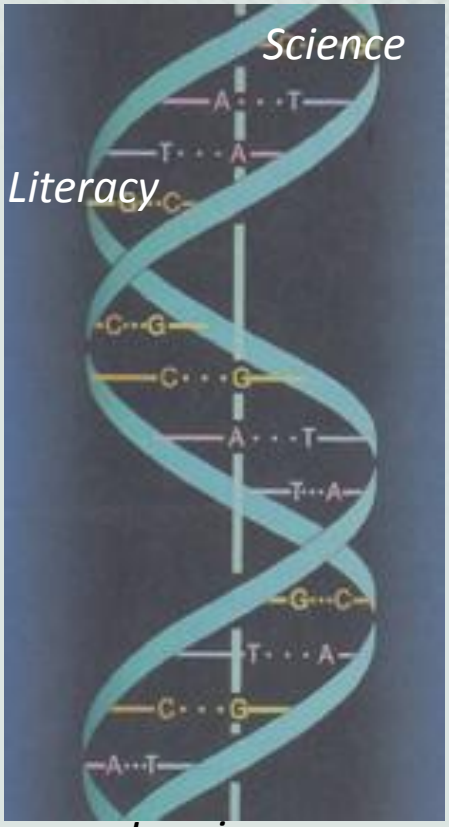
Synergies in the Inquiry Practices of Science and Literacy



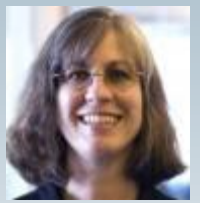


Science as Investigation to explain the natural and designed worlds

second-hand inquiry (data sets, science reports, science diagrams and models)

Literacy as Investigation to construct meaning with science texts

multiple representation systems, science conventions, conceptual and linguistic complexity



Poll: Do you have a vision of what teaching reading as an inquiry practice of science would look like?

A. No, not at all

B. Only a little

C. Moderately

D. Yes, a great deal

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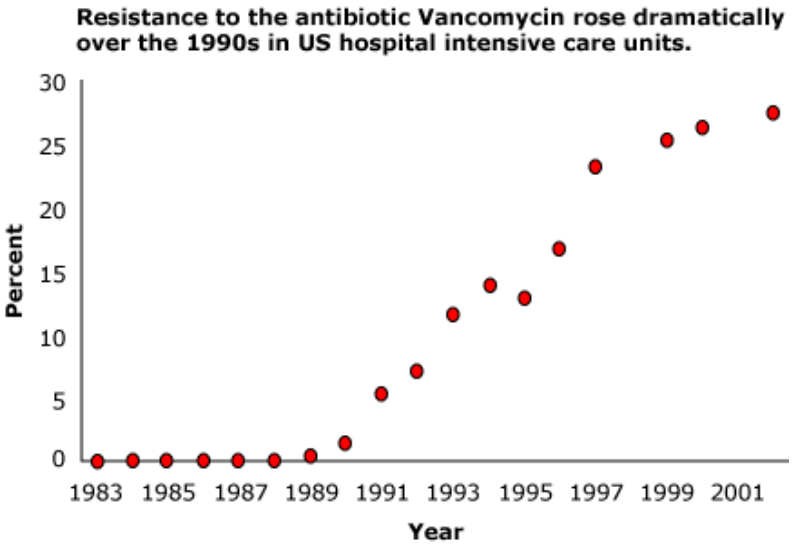
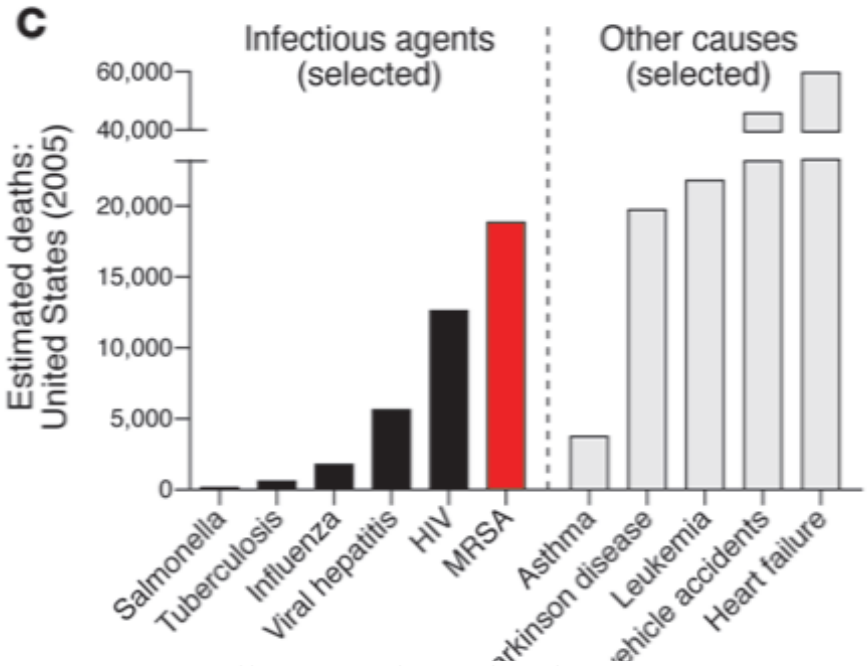
Text-Based Investigation Example: Methicillin-Resistant Staph *Aureus*

- 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 Representations of Science





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

Text Example

Antibiotic/Antimicrobial Resistance

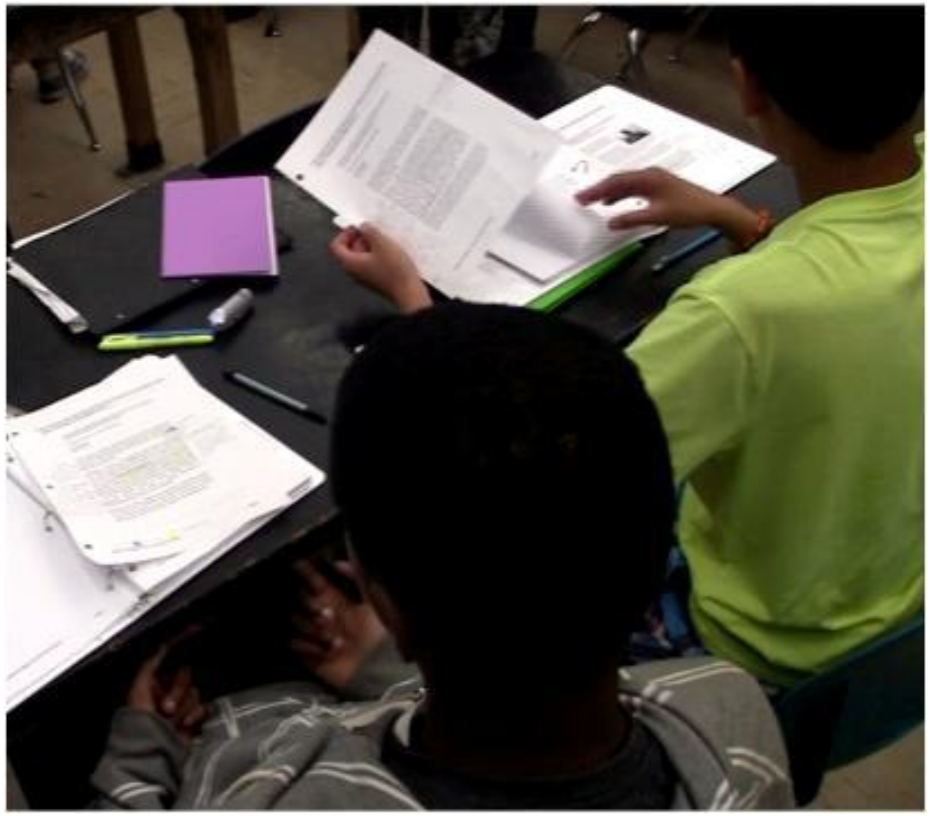
Antibiotics and similar drugs, together called antimicrobial agents, have been used for the last 70 years to treat patients who have infectious diseases. Since the 1940s, these drugs have greatly reduced illness and death from infectious diseases. Antibiotic use has been beneficial and, when prescribed 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

Multiple Opportunities for Explanatory Models and Argumentation

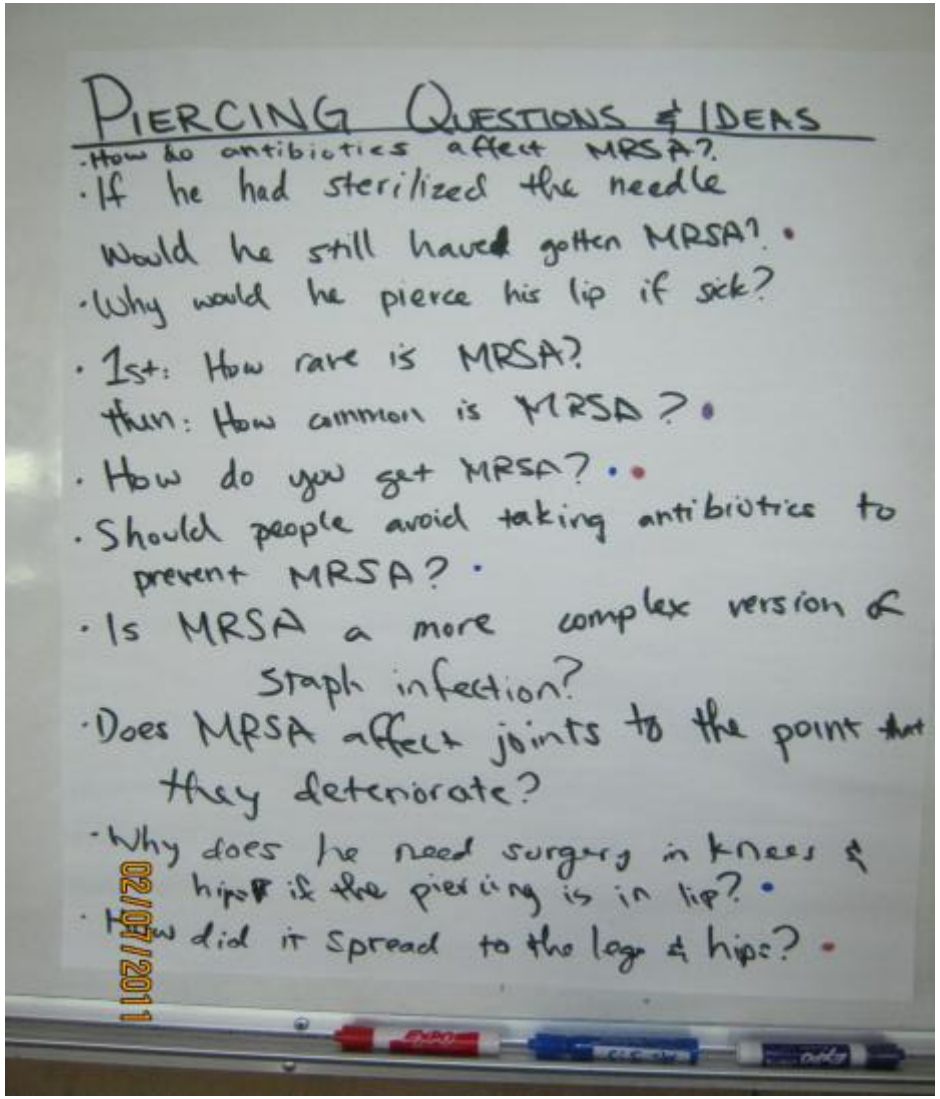
- MRSA Transmission and Infection
- MRSA Spread
- MRSA Evolution
- Managing the Public Health Challenge of MRSA

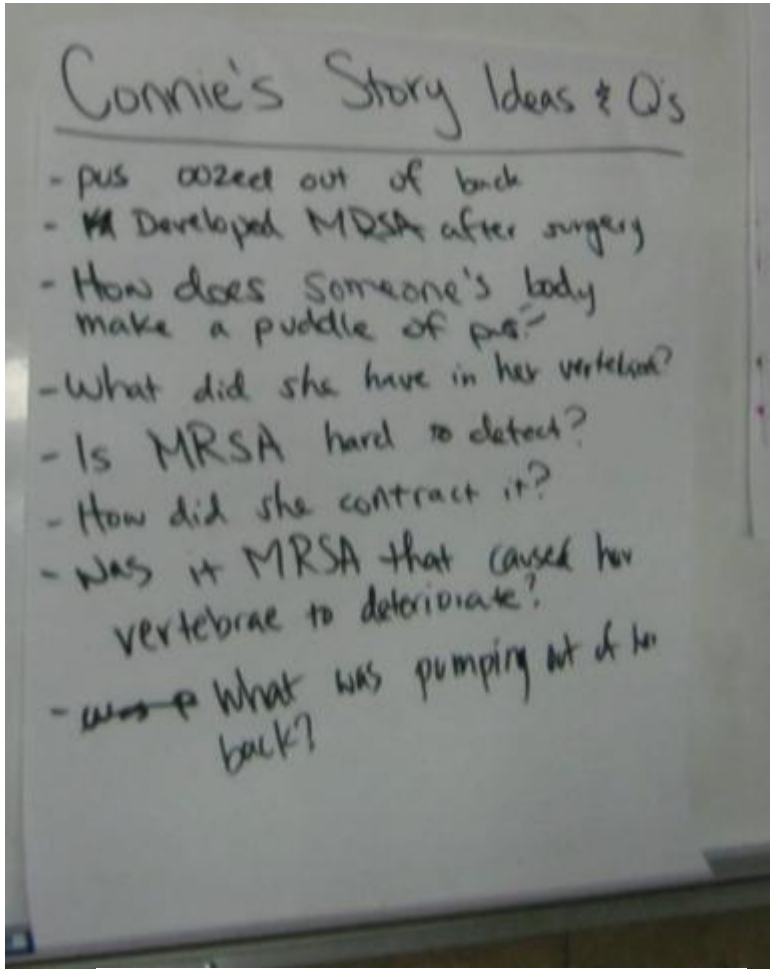
Snapshots of MRSA Investigation from Middle and High School Classrooms



Students engage in close reading of science news on MRSA infections to generate inquiry questions and build knowledge

Students Raise Inquiry Questions to Guide Ongoing Investigation



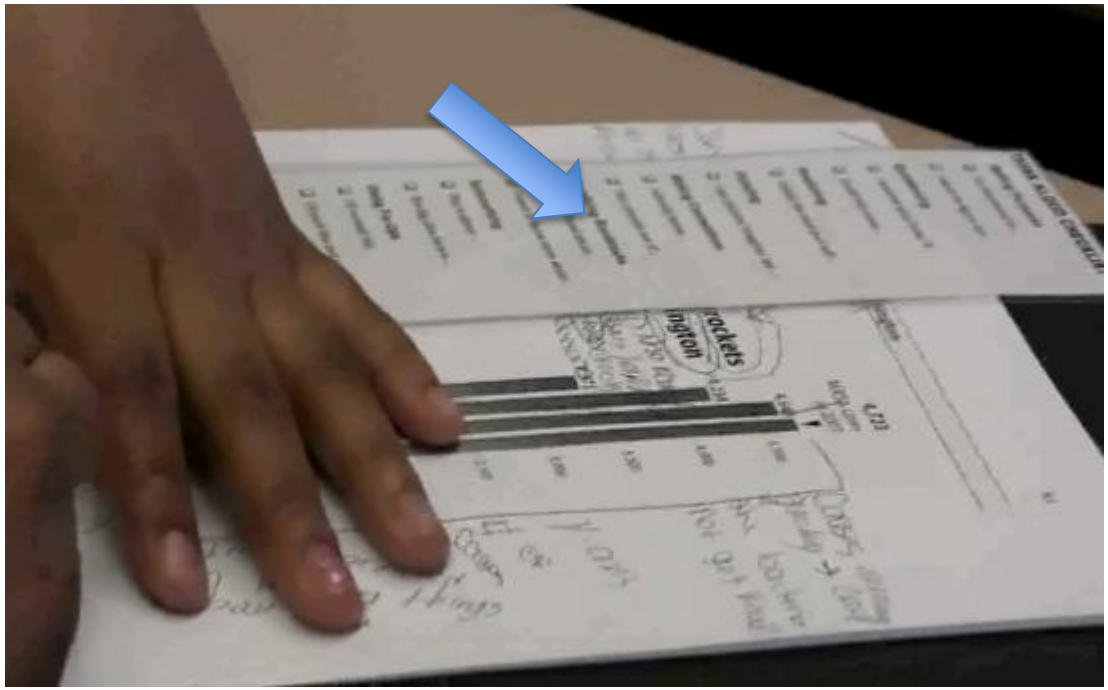


Modeling and Practice of Science Reading Strategies

- Reading and Annotation Routine

  Teacher models active reading strategy

  Students annotate on their own with science reading bookmarks (sentence stems)



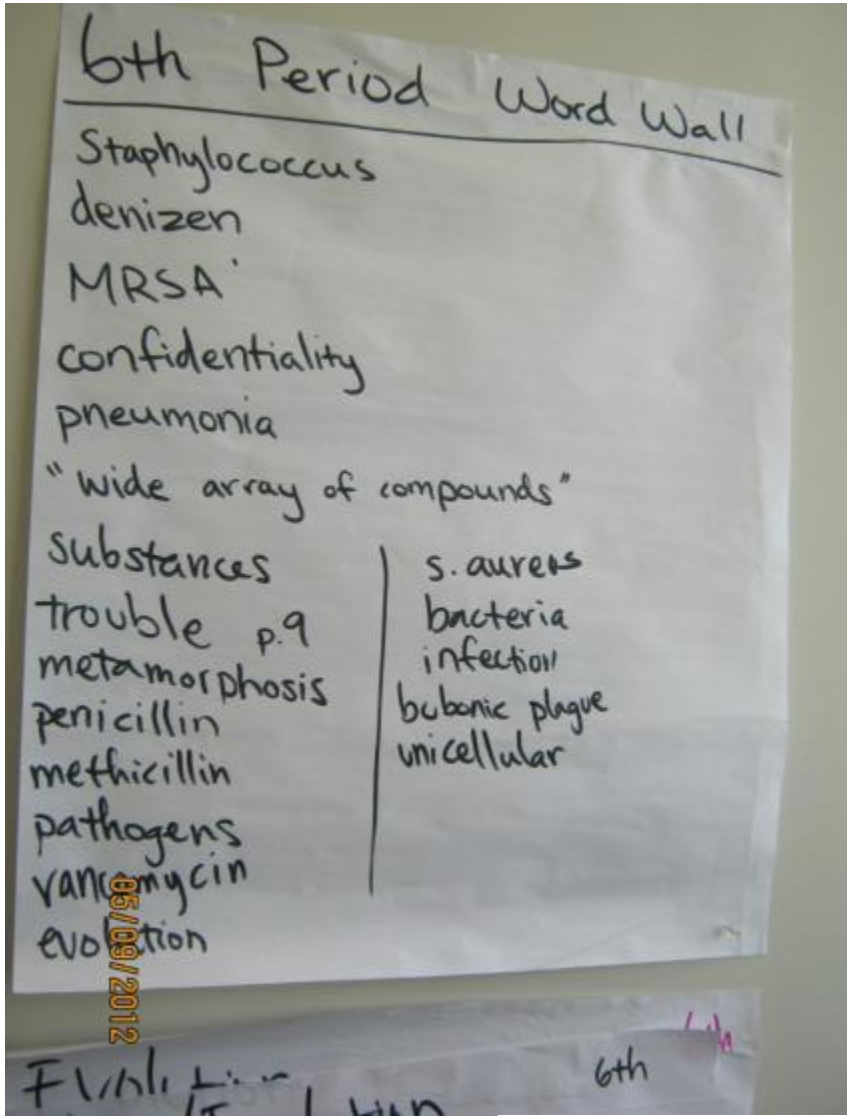
Documenting and Discussing Text Challenges

- Metacognitive Conversation Routines

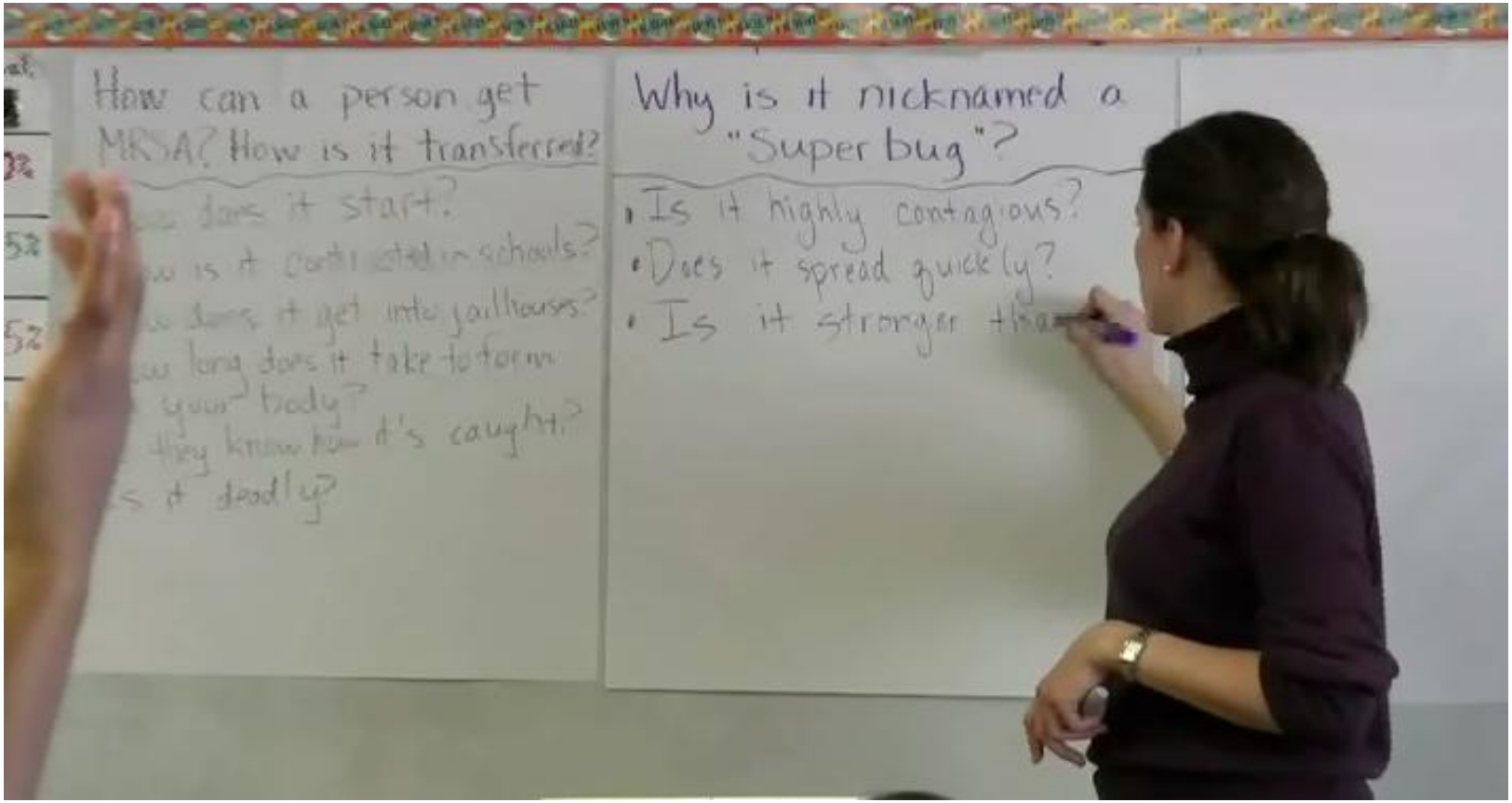
Pair share, class share

Discussion of text challenges

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



Building Knowledge of MRSA Transfer, Spread, and Resistance

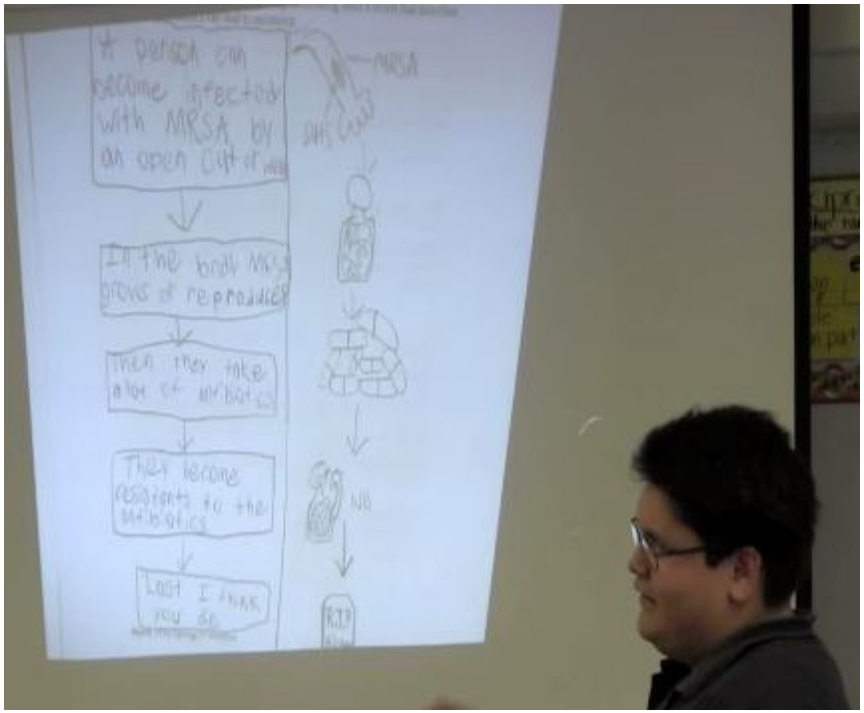


Collaborative meaning making
"Is it hard to kill? Is it strong?"
Making connection to prior texts

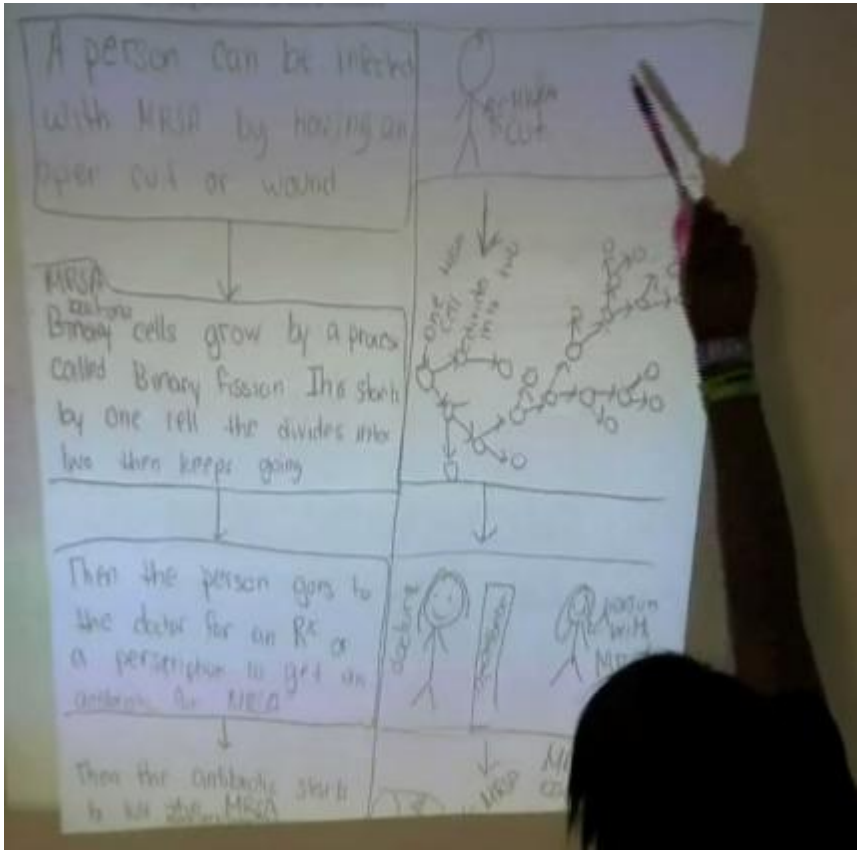
Class Discussion

What did that reading help us understand about …?
What new information/data/evidence do we have that …?
How does that help us explain …?
Which of our inquiry questions got answered?
What new questions do we need to investigate?

Constructing and Critiquing Explanatory Models

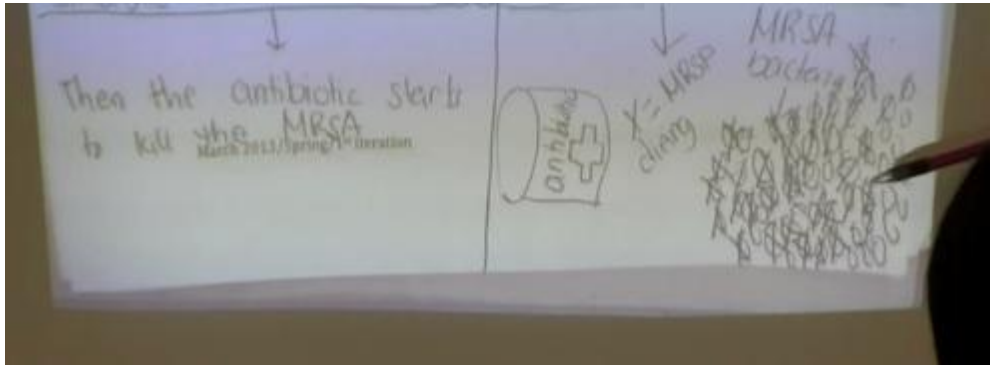


Student 1



Student 2

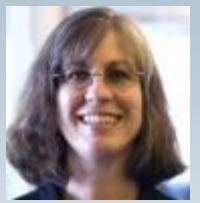
Discussing Models and Raising Questions for Further Investigation



Bottom portion of Student 2's model

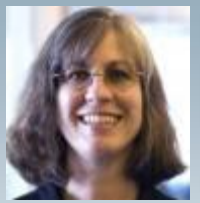
Students explain their models
Other students asked to weigh in
Further questions arise
This spurs continued investigation and sets purpose for next reading

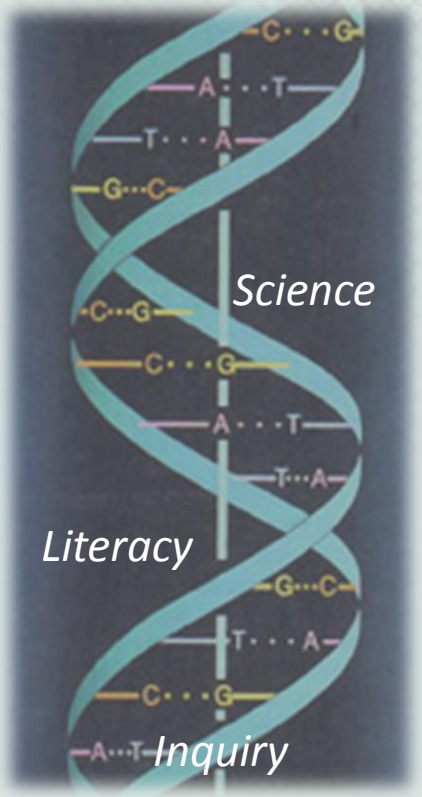
Which of the NGSS Practices Do You See in This Text-Based Investigation?



	Asking questions and defining problems
	Developing and using models
	Planning and carrying out investigations
	Analyzing and interpreting data
	Using mathematics and computational thinking
	Constructing explanations and designing solutions
	Engaging in argument from evidence
	Obtaining, evaluating, and communicating information

Next Generation Science Standards

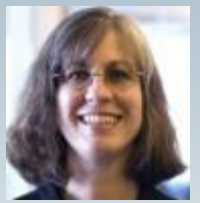




Practice 1. Asking questions and defining problems

Students at any grade level should be able to ask questions of each other about the texts they read, the features of the phenomena they observe, and the conclusions they draw from their models or scientific investigations.

Which of the CCSS for Literacy In Science and Technical Subjects?



√	Cite specific textual evidence to support analysis of science and technical texts
√	Determine the central ideas of conclusions of a text; summarize complex concepts, processes, or information
√	Follow precisely a complex multistep procedure; analyze the specific results based on explanations in the text
√	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used
√	Analyze how the text structures information or ideas; analyze the structure of the relationships among concepts in texts, including relationships among key terms
√	Integrate and evaluate multiple sources of information presented in diverse formats and media in order to address a question or solve a problem
√	Evaluate the hypotheses, data, analysis, and conclusions in a science text, verifying the data and corroborating or challenging conclusions with other sources
√	Synthesize information from a range of sources into a coherent understanding of a

Why Read in the Science Classroom?

New standards offer an unprecedented opportunity to make common cause between literacy and science inquiry

- Integrating literacy and science benefits students' literacy and their science learning simultaneously (e.g. Cervetti, et al., 2012; Fang & Wei, 2010; Greenleaf et al., 2011; Palincsar & Magnussen, 2001; Romance & Vitale, 2001, etc.)
- There is synergy, economy and necessity to doing many things at once

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Why Read in the Science Classroom?

You know how; your students don't (but need to)

- As a more expert science reader and learner, you can model and mentor your students in science reading
- Students need to think critically about sources of information they are exposed to, in school and out!
- Students need to become independent learners
  - builds science pipeline, academic achievement, identity

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You know how; your students may not!

Figure 25.16
Natural gas and oil are typically found in dome-shaped geological formations. Petroleum prospectors drill oil wells to tap into the gas and oil. Sometimes the gas is under pressure and will force the oil up the well pipe, but pumping is usually required.

"Let's say if I got there, if I was there, in real life, whatever, I would know what it is, what the machine is, how it works, how the oil and gas, where they're at."

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You know how; your students may not!

Millions of years ago, marine life settled on the ocean floors and became buried in ocean sediments. Heat, pressure, and the action of bacteria changed this residue into petroleum and gas, which are two important fossil fuels.

Unfamiliar with the world referenced by the text

Marine defined as “people from the army”

Unfamiliar with how to work with unknown words, referents

ocean sediments, this residue

Unfamiliar with grammatical structures in academic text

“So they are saying that millions, long time ago in the marine life, there were ocean floor that had been buried from the ocean.”

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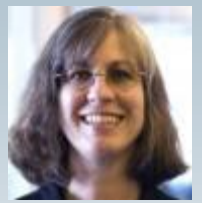
But you can teach them how..



Does that make sense here?

S: I know it's another definition…I'm thinking, like fish, fishes and stuff…

How did you figure that out?

S: I started thinking about Marine World [chuckling]…so it had to be the fish, the fishes and stuff. Then I guess they got buried up under the dirt…[reading] I guess they, as they got buried, it says heat and pressure, I guess the heat and pressure changed, changed their body…

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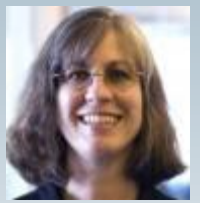
What do you do when you see students struggle with science texts?



	I use powerpoints, videos, and lectures to get the information across
	I look for really easy texts to use
	I use concept attainment tasks (manipulatives) rather than texts
	I ask the literacy resource teacher for help
	I read science texts to my students and explain what they mean
	I have the strong readers in the class read aloud to the others
	I avoid science texts for this reason
	I have students work together to figure them out
	Other

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Why Read in the Science Classroom?

Science texts are cool and varied, just like science

- Diagrams, graphs, models, and other visual displays are conventional forms of science texts, along with print
- Students are inexperienced readers of science; they need to learn *how* to read these varied texts
- Science texts offer challenges (*AKA opportunities*) for both literacy and science learning

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Science Texts Represent Ideas through Multiple Means

EN… SO?

Author: Emily Becker

Thursday, July 10, 2014

http://www.climate.gov/news-features/blogs/enso/en-so

During average (non-El Niño) times, the waters of the western tropical Pacific are much warmer than in the east/central area (Figure 1). As warmer water extends out to the east during an El Niño, it warms the air, causing it to rise (lower pressure) (Figure 2). In turn, there is less rising motion (higher pressure) near Indonesia, due to the relatively cooler waters and overlying air.

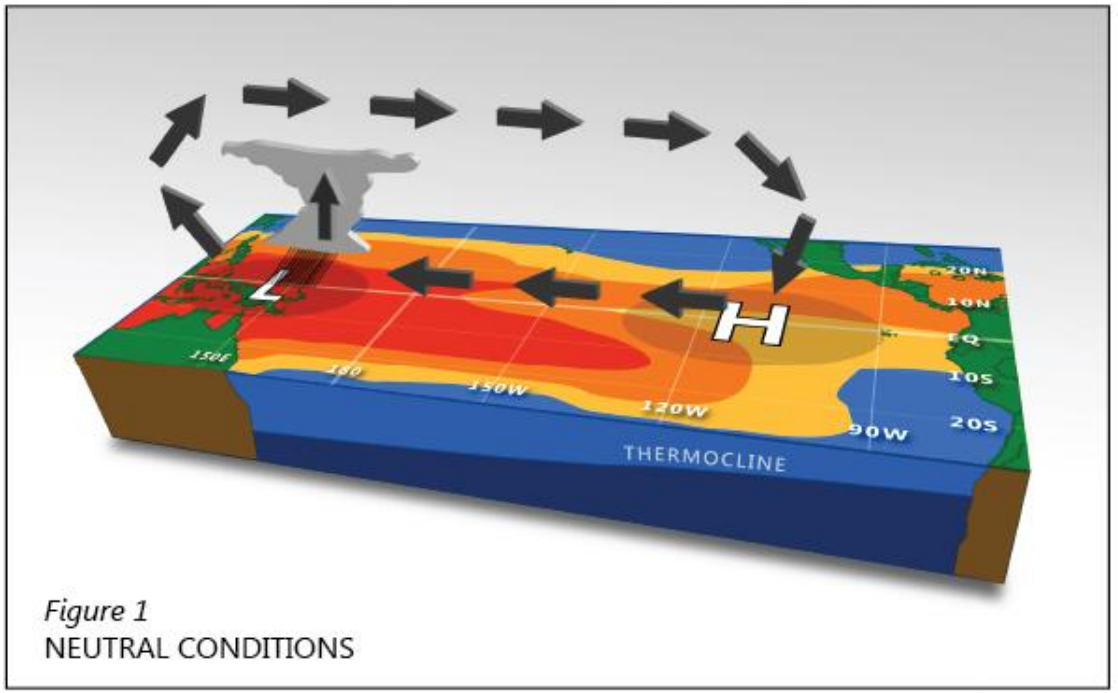


Figure 1
NEUTRAL CONDITIONS

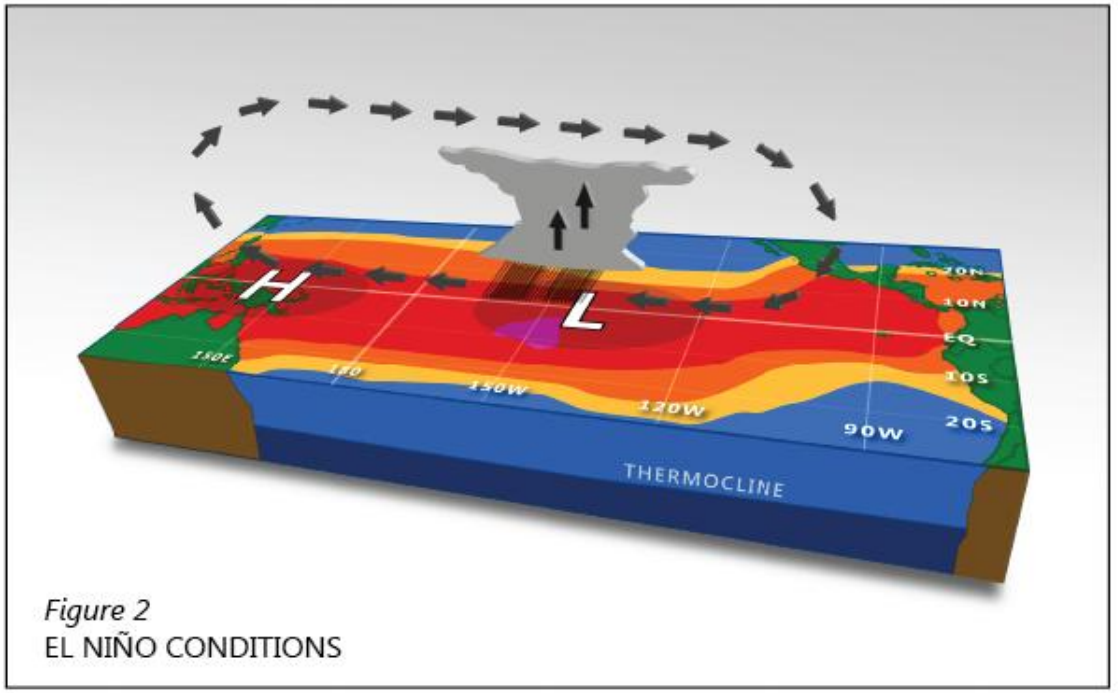
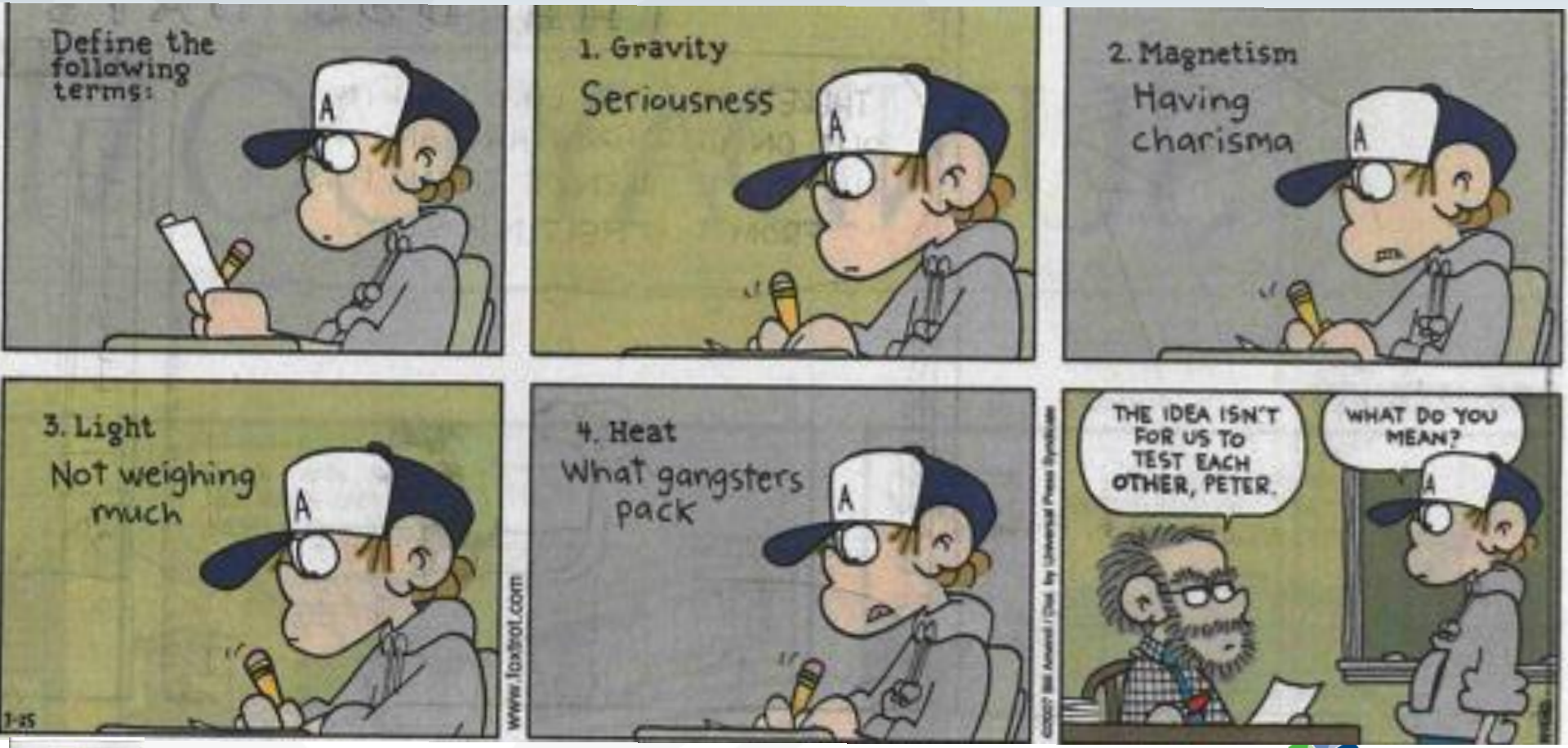


Figure 2
EL NIÑO CONDITIONS

Science Uses Words in Specialized Ways



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Science Texts Compact Ideas Densely for Efficiency

$[H_3O^+]$ X $[HO^-] = 10^{-14}$ $(mol/L)^2$

An Argument for the Cometary Origin of the Biosphere by Armand Delsemme

The first 600 million years of our planet's history have been erased from its surface. Between the time it was formed about 4.6 billion years ago and the formation of the oldest known sedimentary rocks, which are about 4 billion years old, the Earth changed from a hot, dry little rock to a world with an ocean and an atmosphere – a planet that was primed for the origin of life.

American Scientist, September-October 2001 Volume 89, Number 5 Page: 432 DOI: 10.1511/2001.5.432

Each of these science text types presents problems of comprehension to the science reader/science learner (and therefore presents *opportunities to learn* how to tackle them)

Raise your hand if you love all of these cool science texts.

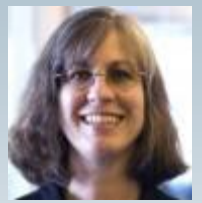
Why Read in the Science Classroom?

Science texts serve many roles for scientists and for science learners (Yore, 2004; Cervetti & Barber, 2008)

Scientists	Students
Situate their research	Provide context
Search for information about topics of interest	Deliver content
Learn about methods they might use	Provide models
Learn about other scientists' findings and critique their conclusions; use second-hand data for new investigations	Support second-hand investigations
All of the above	Support first-hand investigation

(Cervetti, G. N., & Barber, J. (2008). Text in hands-on science. In E. H. Hiebert & M. Sailors (Eds.), *Finding the right texts: What works for beginning and struggling readers* (pp. 89-108). New York, NY Guilford.)

Provide Context



- introduce domain and/ or context
- invite students to engage with the context
- connect to the world outside the classroom

Roots of Reading, Seeds of Science, scienceandliteracy.org

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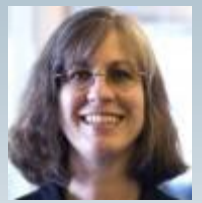
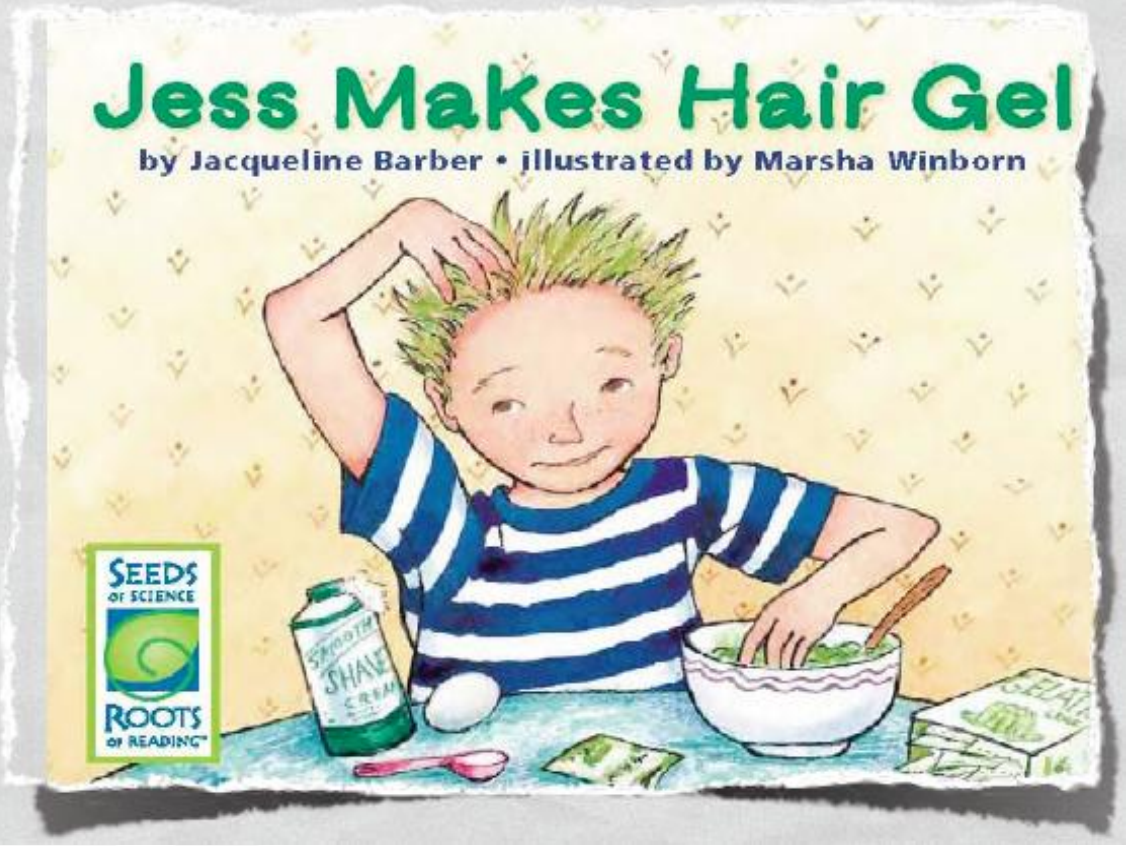
Provide Models



- model inquiry processes
- model nature of science
- model literacy processes



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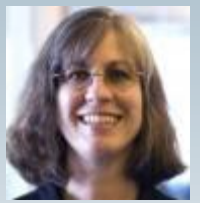
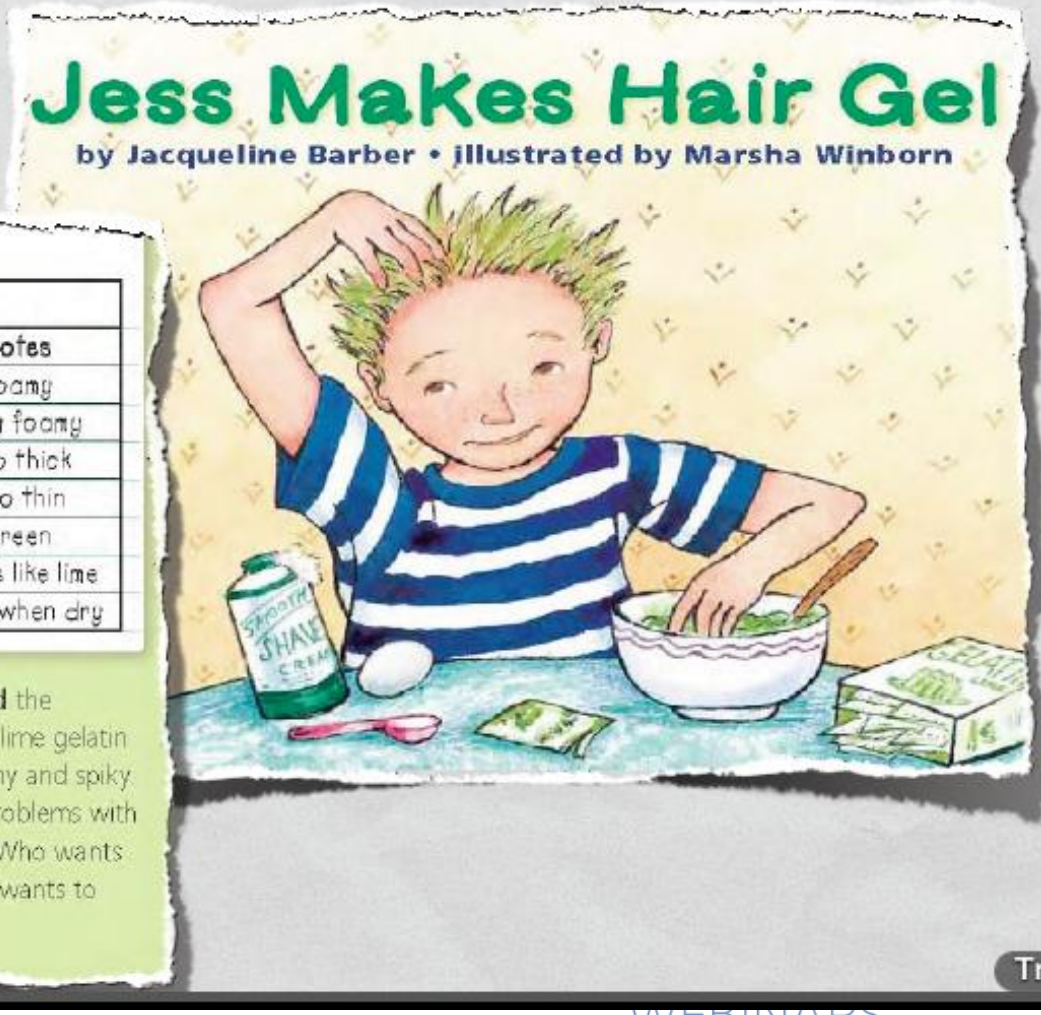
Support Second-Hand Investigations



- provide data for students to interpret

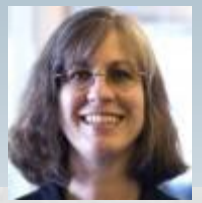


Jess's Substance Table

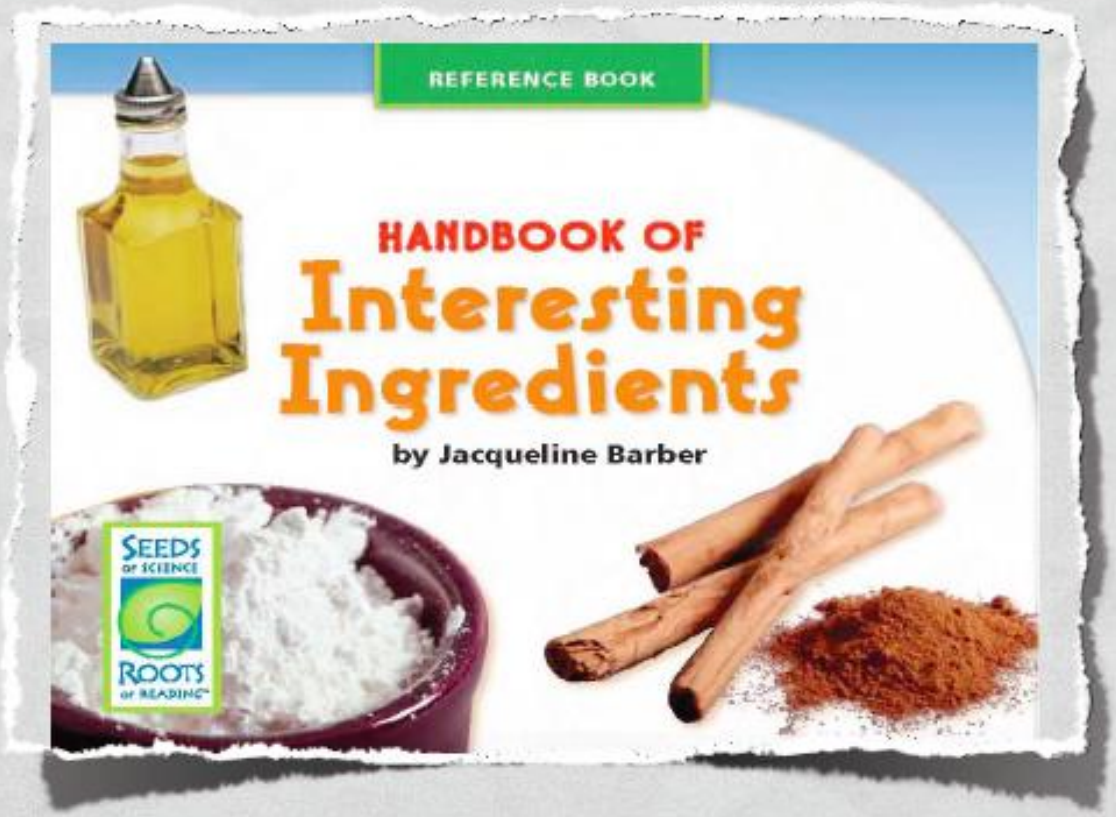
Substance	Properties		
	Looks shiny	Makes spikes	Notes
Shampoo	yes	no	foamy
Shaving cream	no	yes	very foamy
Egg whites	yes	no	too thick
Corn syrup	no	no	too thin
Lime gelatin	yes	yes	green
			smells like lime
Glue stick	no	yes	hard when dry

Jess **compared** the substances. Only lime gelatin made his hair shiny and spiky. But there were problems with the lime gelatin. Who wants green hair? Who wants to smell like lime?

Support First-Hand Investigations



- provide information that facilitates firsthand investigations
- support students in making sense of firsthand investigations
- inspire firsthand investigations



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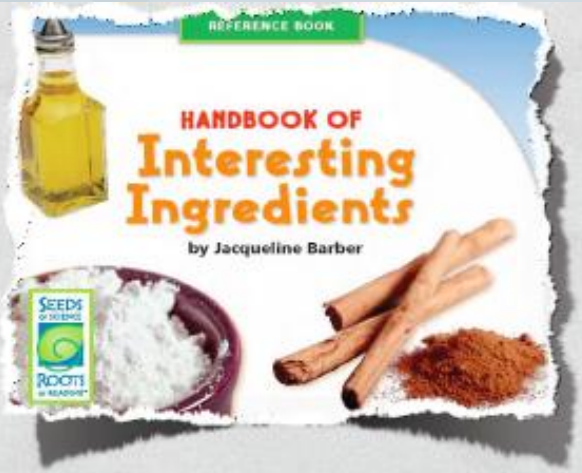
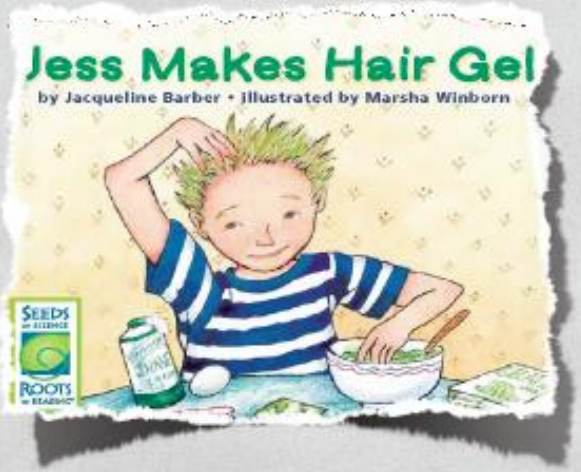
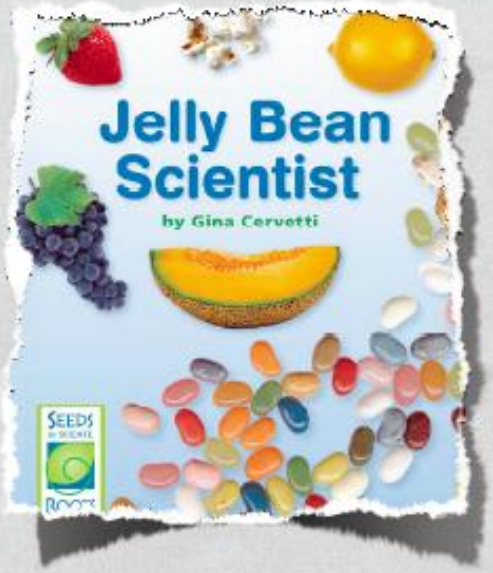
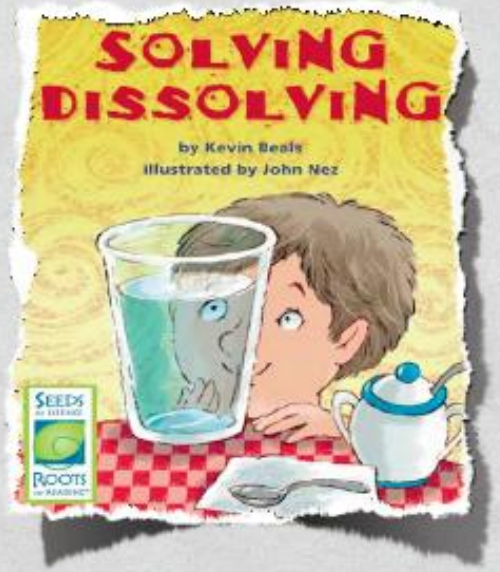
Deliver Content

- deliver science information
- provide information and explanations about unobservable phenomena









Roots of Reading, Seeds of Science, scienceandliteracy.org

Why Read in the Science Classroom?

Inquiry and meaning making practices are similar in close reading and science investigation

- Asking questions, exploring possibilities, building coherence, making connections, making inferences, testing hypotheses

Approached as inquiry into meaning, engaged science reading develops inquiry dispositions

- Curiosity and puzzlement, tolerance for ambiguity
- Stamina and persistence in the face of challenge, self efficacy and confidence
- Metacognition, monitoring conceptual change

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Diagram Detective: What Does an Arrow Mean?

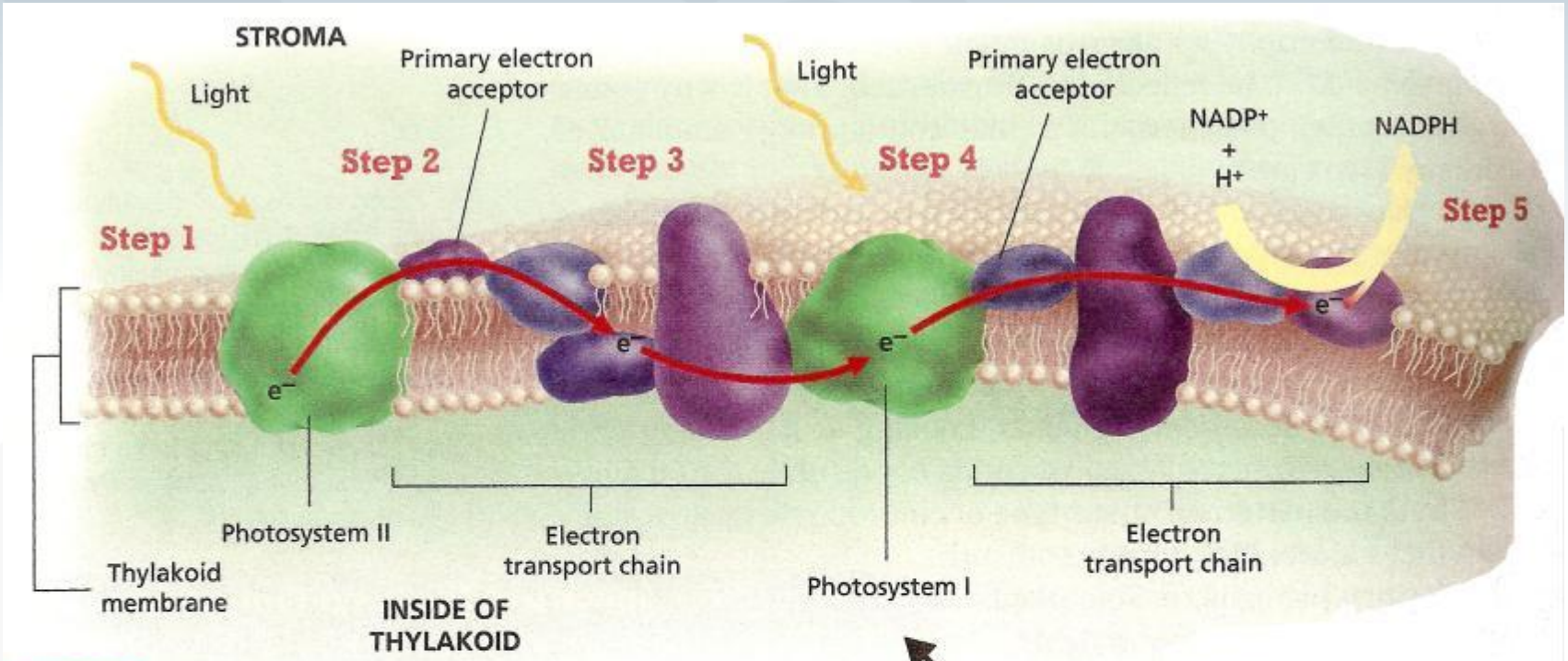
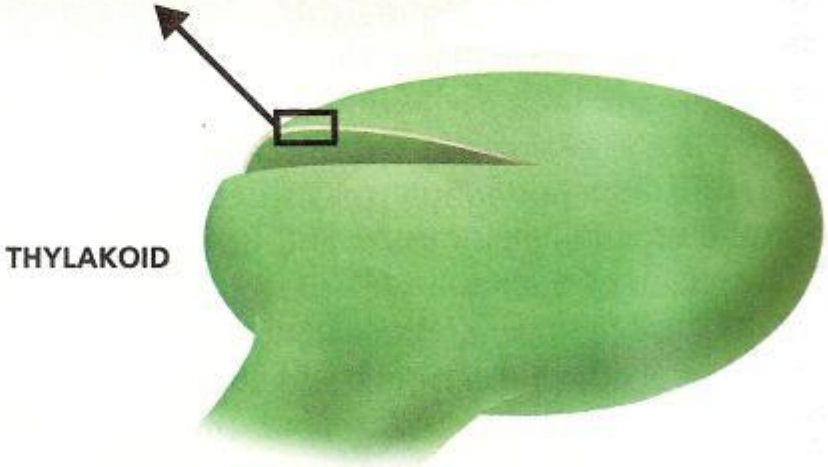


FIGURE 6-5

The light reactions take place in the thylakoid membrane and involve several steps. Step 1: Light excites electrons in chlorophyll *a* molecules of photosystem II. Step 2: These electrons move to a primary electron acceptor. Step 3: The electrons are then transferred along a series of molecules called an electron transport chain. Step 4: Light excites electrons in chlorophyll *a* molecules of photosystem I. As these electrons move to another primary electron acceptor, they are replaced by electrons from photosystem II. Step 5: The electrons from photosystem I are transferred along a second electron transport chain. At the end of this chain, they combine with $NADP^+$ and H^+ to make NADPH.



from Modern Biology, Holt, Rinehart, Winston page 114, FAIR USE

Sentence Detective: What Does a Complex Sentence Mean?

The first 600 million years of our planet's history have been erased from its surface. Between the time it was formed about 4.6 billion years ago and the formation of the oldest known sedimentary rocks, which are about 4 billion years old, the Earth changed from a hot, dry little rock to a world with an ocean and an atmosphere – a planet that was primed for the origin of life.

An Argument for the Cometary Origin of the Biosphere by Armand Delsemme
American Scientist, September-October 2001
Volume 89, Number 5 Page: 432

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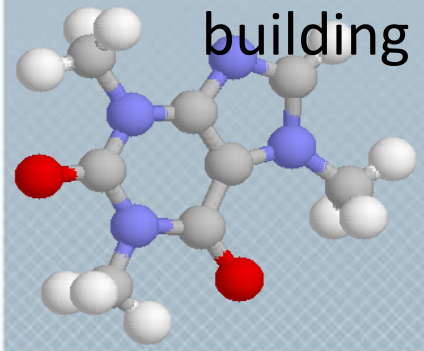
Word Detective: What Does an Unfamiliar Word or Word Use Mean?

The Word Wall grows organically from student nominations in Abby Noche's AP Biology classroom in New Haven Unified School District

Why Read in the Science Classroom?

Teaching approaches to support science reading and science inquiry practices overlap

- Making thinking visible, collaborating in a community of sense makers, modeling and mentoring, discussion
- Journaling, visual note-making, word learning strategies, model building



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To Advance Students' Science Reading and Science Learning, They Need to Be..

A grand shift in pedagogy is needed to support students in doing the intellectual work

- Grappling, inquiring, raising questions
- Making meaning
- Building knowledge
- Identifying and solving problems
- Generating, finding, and using evidence
- Constructing and critiquing arguments

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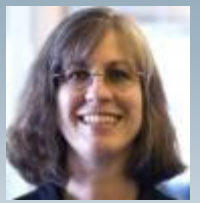
Modeling and Mentoring with Familiar Metacognitive Routines



Engage in a task (reading a passage, designing a science investigation, carrying out a lab)

Turn the tables on what "counts"

What was confusing?
How did you figure that out*?*

Share and record *how* the class members approach it

- Think Aloud (Teacher Modeling, Partner Think Alouds)
- Annotation (Talking to the Text followed by Pair/Small Group Problem Solving)
- Reciprocal Modeling of Problem Solving Strategies (I do, we do, you do)
- Collaborative Meaning Making (reading in the classroom)
- Gradual Release of Responsibility

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Will Brown's Intro to Chemistry Class

Click on the link in the chat window:
https://www.youtube.com/watch?v=ickLXQqGIy0&feature=youtu.be

Or

http://readingapprenticeship.org/research-impact/videos/classroom/

And scroll to Intro to Chemistry video

Please give us a green check when you are finished.

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What did you notice?

How did the teacher, Will Brown:

- Invite students to share puzzlement about reading and about science?
- Engage students to make meaning of complex text?
- Build connection between reading and hands-on investigations?

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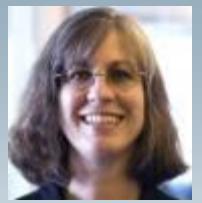
Meaning Making *with* and *through* Science Texts



With the text

- Looking *at* the text as a conveyance of science ideas and information
- Making sense of the conventions of science communication (puzzling through, breaking the code)

Through the text

- Looking *through* the text to the science ideas and information it conveys
- Puzzling through the information, claims, and evidence
- Using texts to build explanations of science phenomena

What does it mean? How do we know? What is puzzling? How can we figure it out?

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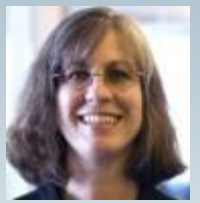
Construct a "Living" Reading Strategies List



What is one thing you did to make sense of this text?

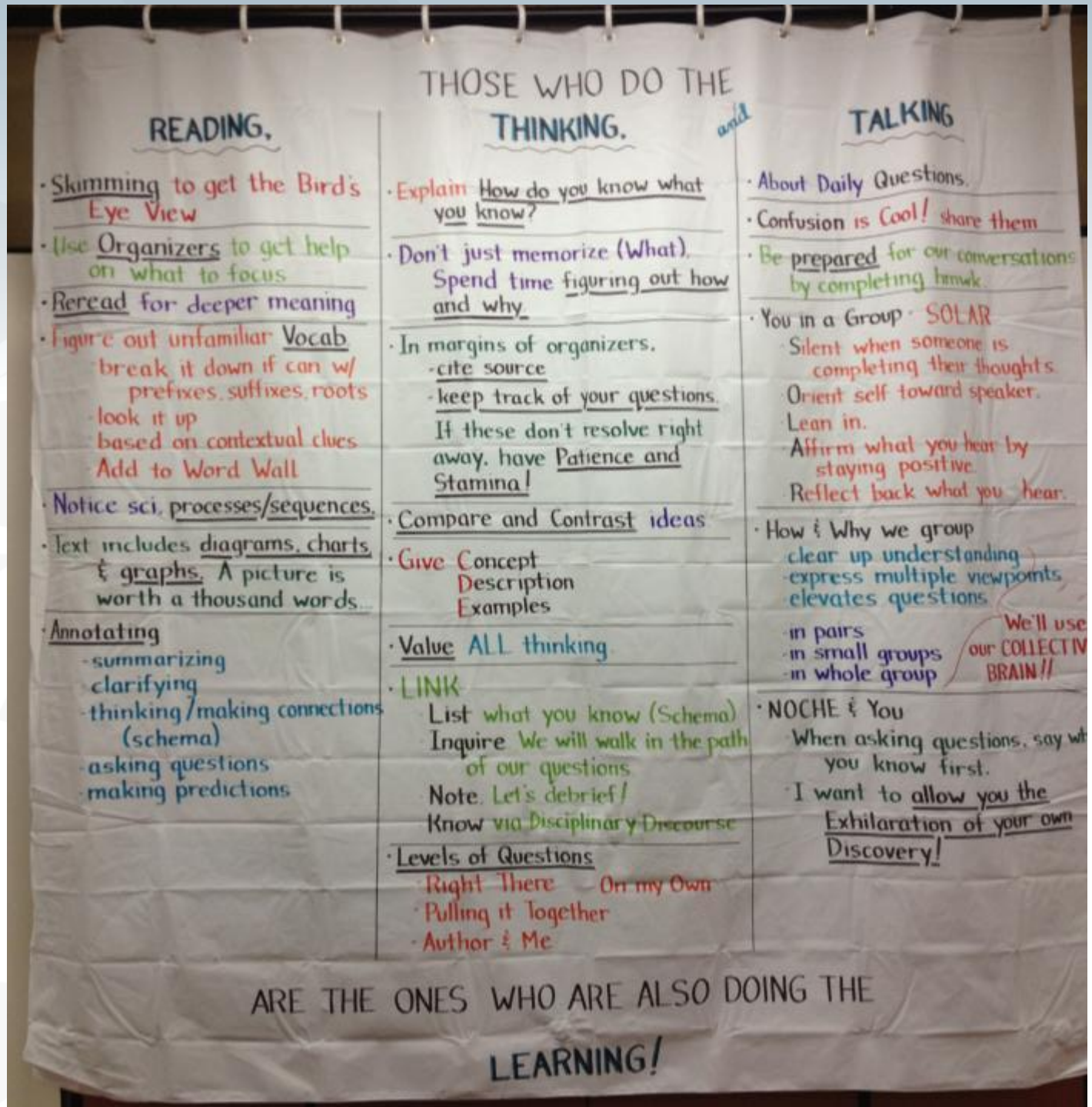
- When? Where? Why?
- How did it affect your understanding?

What got in the way? What was confusing?

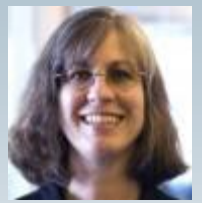
- What problems did you solve? How?
- What problems remain?

Reading for Understanding, p. 94-95

Abby Noche's classroom "Shower Curtain" captures students' ideas about what works well in science reading, thinking, and discussion over time



Metacognitive Dual-Entry Logs and Journals



EVIDENCE (I saw/noticed/read)	INTERPRETATION (I thought/ wondered)

Reading for Understanding, p. 112-113

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Science Reading Bookmarks

Questioning

A question I have is …

I wonder about …

Predicting

I predict that …

I think this is …

This is important because …

Visualizing

I can picture …

I can see …

Making Connections

This is like …

This reminds me of …

This is an example of …

Identifying a Problem

I'm confused about …

I'm not sure of …

I didn't expect …

Summarizing

So what it is saying is …

The big idea here is …

Using Fix-Ups

I'll re-read this

I'll read on & check back

Modeling

This helps me explain …

This goes against …

This reinforces …

So the cause(s) is/are …

So the effect(s) is/are …

Science Sentence Frames to Prompt Reading/ Thinking/ Discussion

Asking Questions

- What I read … on page xx, I wondered…
- After I read … on page xx, I got confused about … because …
- On page xx I could not understand why …
- Do you think it makes sense that …?

Offering Evidence

- I think one reason is on page xx, where it says …
- I don't think … could be true because on page xx it says…
- If … is true, then that is a good reason to think that … is true.
- Even though … is true, on page xx, … is stronger evidence for the opposite.

Building on Ideas

- I agree with your idea that … and I would like to add …
- I like your idea that … Do you think that means …?
- I have a different idea. To me, the evidence … on page xx means …
- Would you agree that there is a connection between … and …?

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Ask Questions that Support Rather than Test Comprehension

Supporting

What was hard to understand in that passage?

What was confusing that we need to work on together as a whole class?

Did anyone find a way to figure that out?

Testing

Who can tell me how many _____?

What happens when _____?

What are the stages of _____?

What is _____ called?

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Ask Questions that Build Rather than Test Knowledge

Building

What was new for you in that text?

How does that help us explain _____?

Did anyone find any evidence we should add to our model?

How would that work?

According to the text, how does ____ lead to _____?

What causes _____?

How many ____of ____ are there?

If you add _____, what happens?

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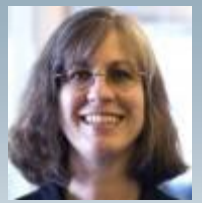
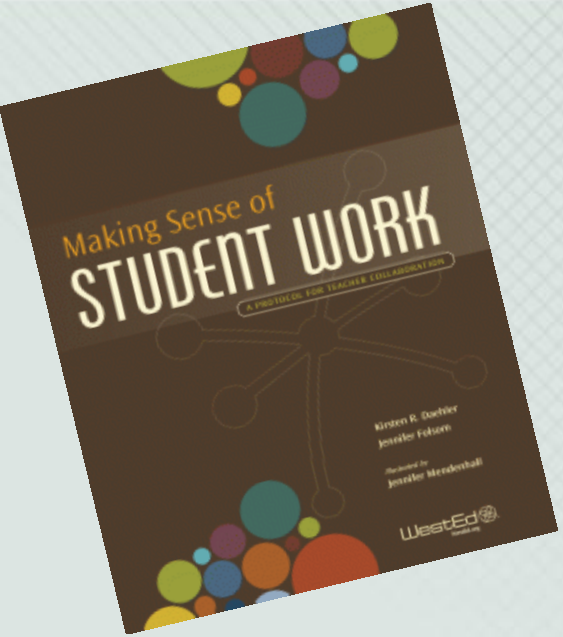
Grade and Assess Learning not just Knowing





Value effort and growth in science inquiry practices

Value effort and growth in science reading

Develop and share learning goals and criteria with students

Assessment resources on website: readingapprenticeship.org

- Curriculum Embedded Reading Assessment and rubric
- Student Science Reading Goals

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Why Read in the Science Classroom?

We can make reading science texts more like doing real science

- Repurposing science texts
- Approaching science reading as inquiry
- Fostering interplay with laboratory investigations

Good models of “science inquiry with texts” point the way

- Text-based and text-enriched investigations and inquiry science at elementary, middle school, and high school levels

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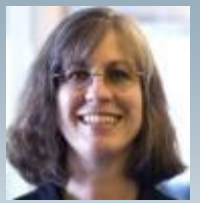
Concept Oriented Reading Instruction, Upper Elementary

http://www.corilearning.com/



Children work in groups on extended projects of their own choosing, selecting topics such as threats to the Chesapeake Bay watershed.

- They find books within the classroom and school media center relevant to their topics.
- They engage in hands-on experiences.
- They fill notebooks with information from multiple sources, including Web sites and reference materials.
- They share resources and help each other piece together an understanding of the watershed.

Instructional goals include engagement, fluency development, reading and science goals, comprehension strategy instruction, writing and communicating, and extended reading.

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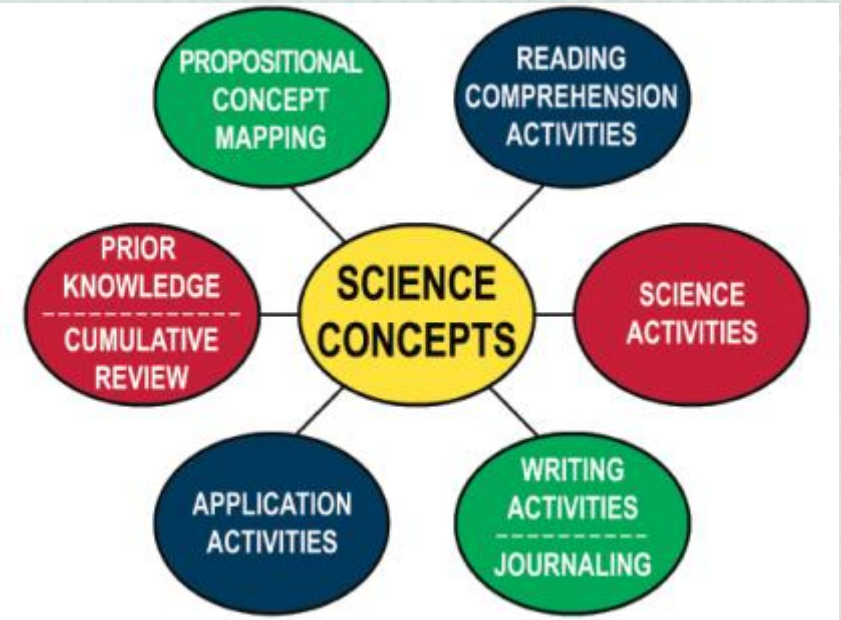
In-Depth Expanded Applications of Science (IDEAS)

http://scienceideas.org/



Students engage in a variety of inquiry-oriented hands-on, reading comprehension, writing/journaling, and concept mapping activities, all of which focus on the science concepts to be learned.

Concept-focused activities build student in-depth understanding of core science concepts, while improving their ability to read with comprehension and to represent the cumulative conceptual knowledge they have gained.

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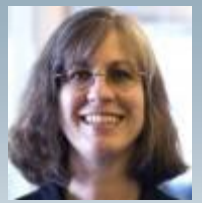
Roots of Reading, Science of Science

www.scienceandliteracy.org



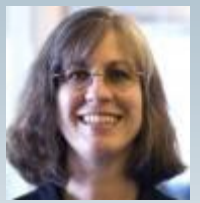
Seeds of Science/Roots of Reading is a 2nd-5th grade curriculum that integrates science and literacy to provide access to deep science knowledge, academic vocabulary, and powerful skills and strategies in both literacy and science.

It is designed to reflect the practices of real scientists, and to meet the needs of all students, including English language learners.

Each *Seeds of Science/Roots of Reading* unit includes student books, materials for hands-on activities, assessments, a teacher's guide, and more.

Books play a variety of roles, such as providing context for students' investigations, modeling scientific processes, supporting both first- and second- hand inquiry, and providing content that is difficult to observe firsthand.

Guided Inquiry Supporting Multiple Literacies (GIsML)

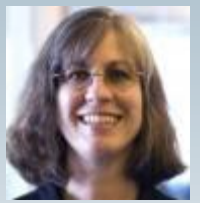


Scientist's Notebooks: texts designed to model scientific inquiry processes

- Identify the problem the (fictitious) scientist is investigating
- Think aloud about how she can accurately model the phenomenon for the purposes of investigation
- Making decisions about how she will most effectively represent the data she is collecting
- Share her data and the claims that she believes she can make from these data
- Respond to the critical reactions of her colleagues as they weigh the evidence for her claims
- Revise her thinking as she gathers new data or considers alternative explanations

Magnussen, S. & Palincsar, A. (2004). Learning from text designed to model scientific thinking in inquiry-based instruction.

Reflections



What ideas do these examples of integrated literacy and science teaching and learning bring to mind for your own teaching? for the teachers with whom you work?

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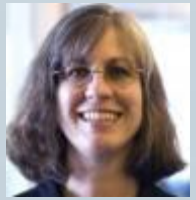
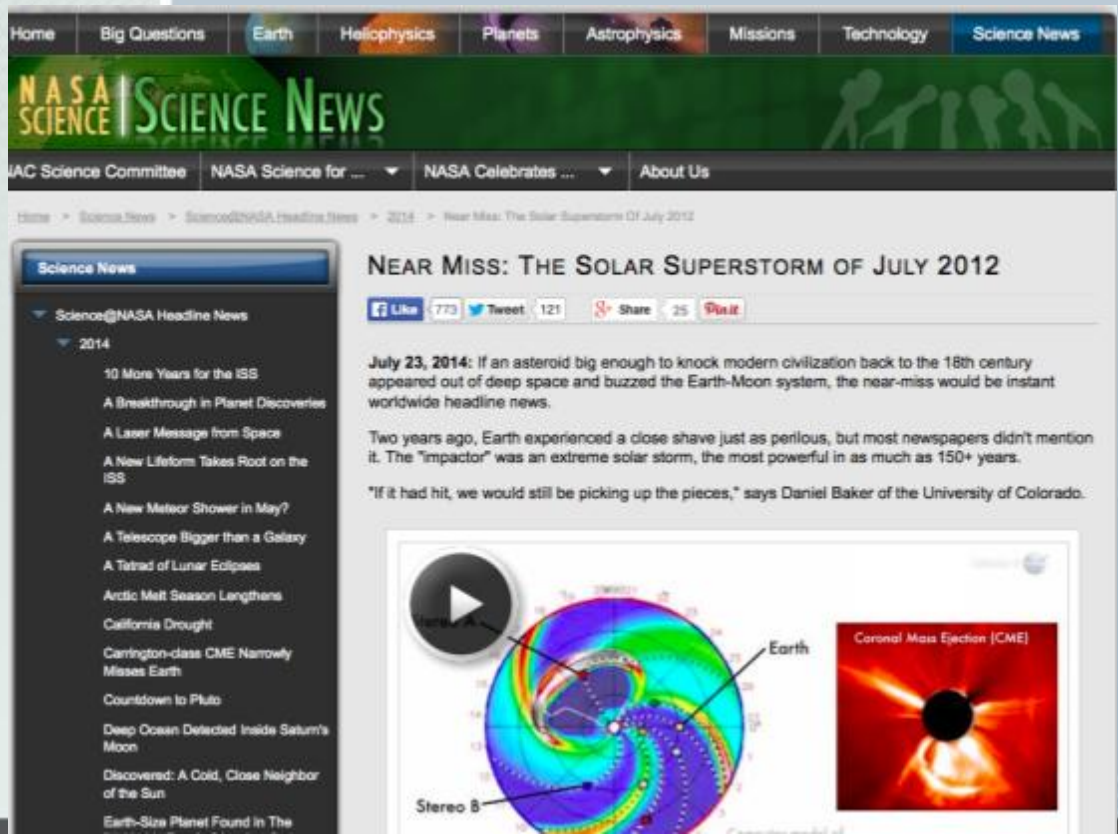


Why Read in the Science Classroom?

Resources abound

- Science news reporting, trustworthy websites, trade journals, trade books, and even the textbook



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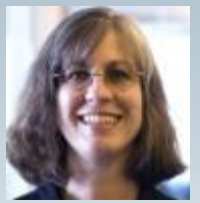
Resources that Support Meaningful Science Reading



Reliable websites offer multiple texts and representations to read on science topics of keen interest

- (NASA, NOAA, CDC, university science departments, science museums)

Science magazines for children, students, public

Science news (New York Times)

Textbooks (repurpose for inquiry, use excerpts)

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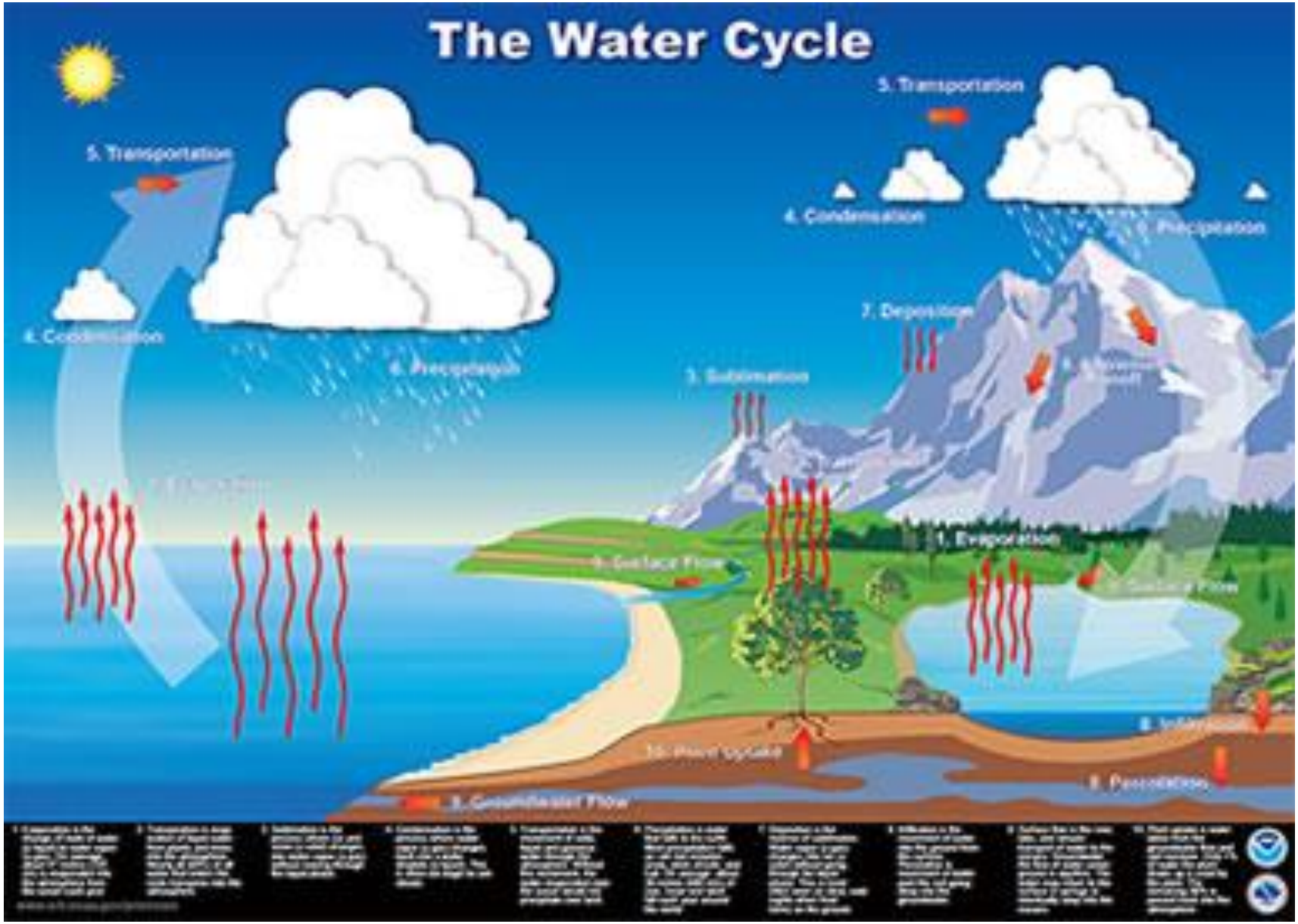
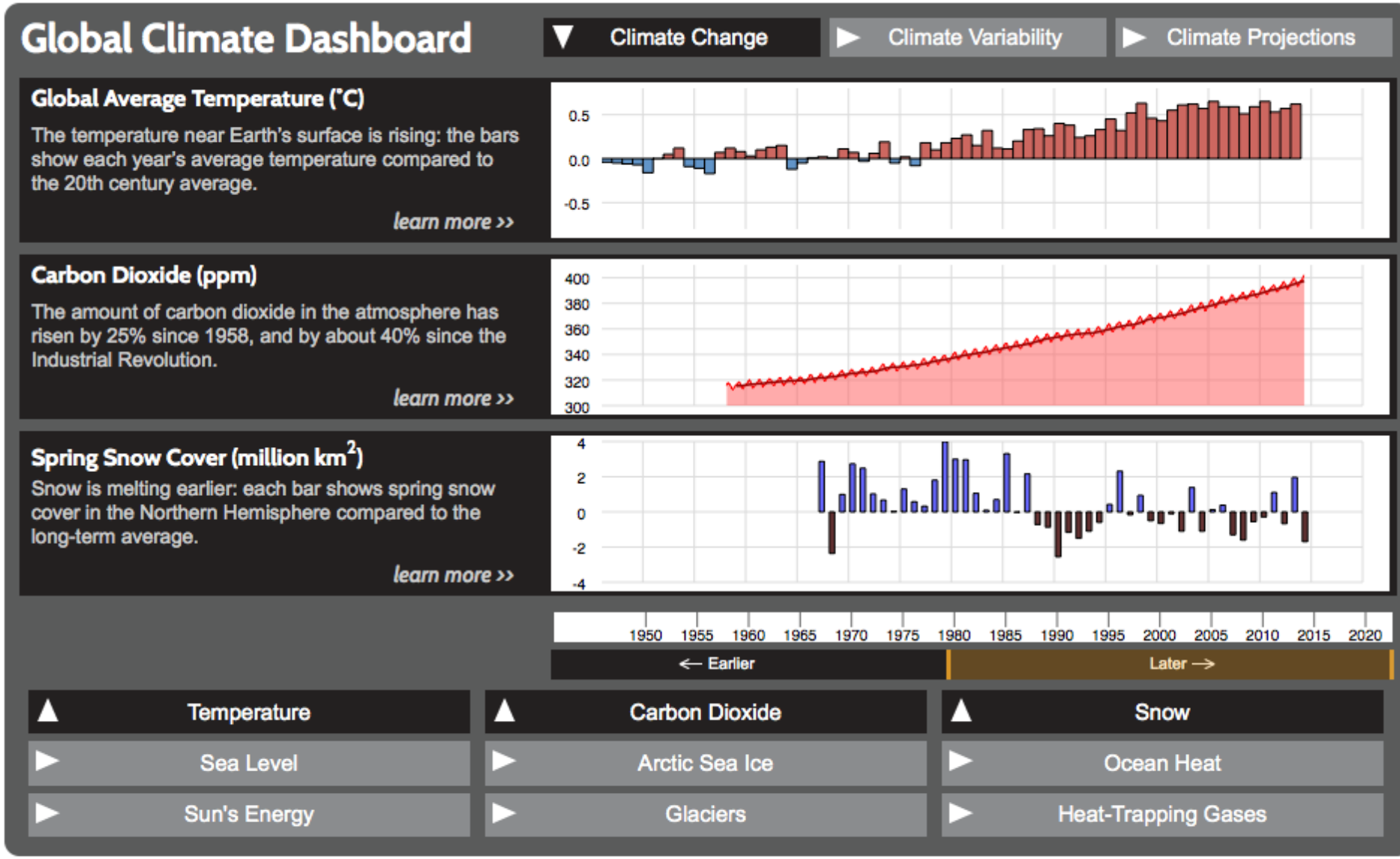


http://www.education.noaa.gov/Freshwater/Water_Cycle.html

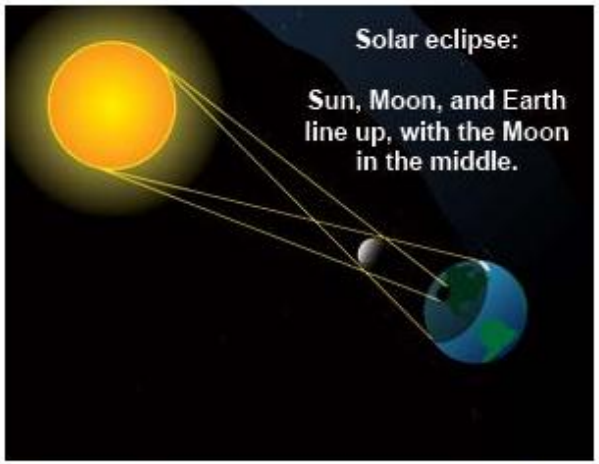
NOAA Data Portal



NASA website

An eclipse happens when one object in space gets right in front of another object in space. Seeing that happen is awesome! And it is a chance to learn more about one or both of the objects.

Depending on what gets in front of what, we have different names for the eclipse.

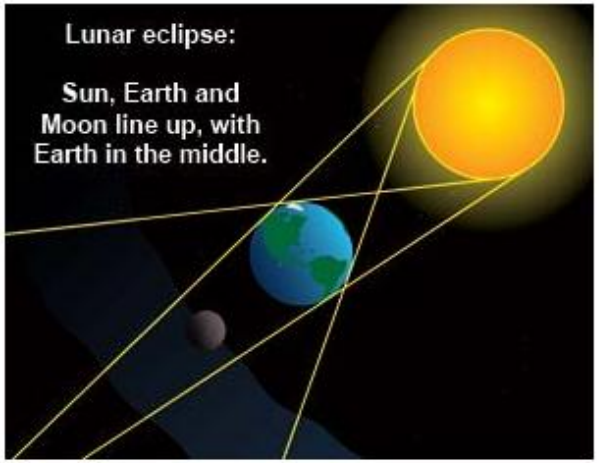


When the Moon passes between us and the Sun, we call it a solar eclipse. It is the Sun that is being "eclipsed" (meaning hidden or blocked from sight).

To form an eclipse, the two objects and the observer must be located along a straight line.

These are the most notable eclipses we see on Earth. During a solar eclipse, daylight gets dimmer for a few minutes, then returns to normal. During a lunar eclipse, the Moon may look like an orange ball. We can still see it because it reflects some sunlight that has grazed Earth's atmosphere, becoming reddened and scattered by the atmosphere as if at sunset.

There is one other very rare eclipse that we can also see happening before our very SHIELDED eyes. That one is called a "Venus transit." Venus orbits closer to the Sun than Earth does. Sometimes Venus passes between Earth and the Sun. When things are lined up just right, we can see Venus as a small black dot moving across the face of the Sun.

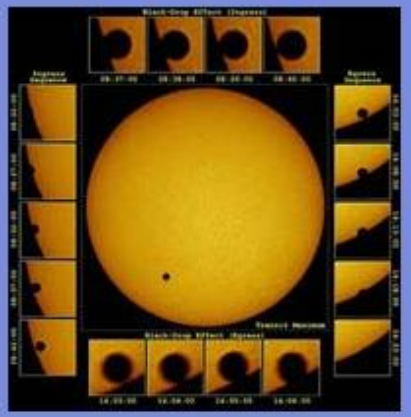


When Earth passes right between the Sun and the Moon, we get a lunar eclipse.

How often can we see a Venus transit?

venustransit.nasa.gov/transitofvenus

During a lunar eclipse, the Moon glows a soft orange. It is lit by scattered, reddened sunlight that has grazed Earth's atmosphere as if during a sunset. Credit: Anthony Ayiomamitis, Athens, Greece.



This series of photos shows the progress of Venus across the face of the Sun during the Venus transit of 2004. Credit: Anthony Ayiomamitis, Athens, Greece.

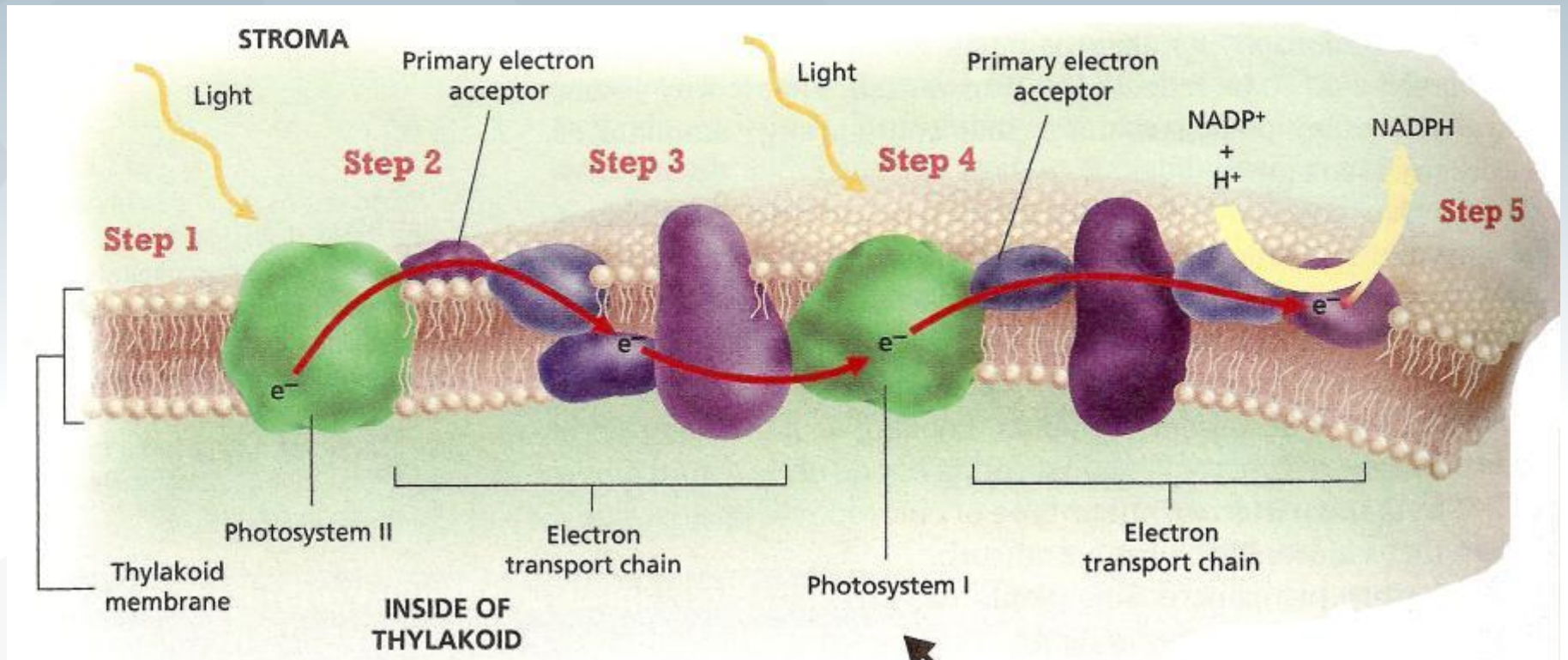
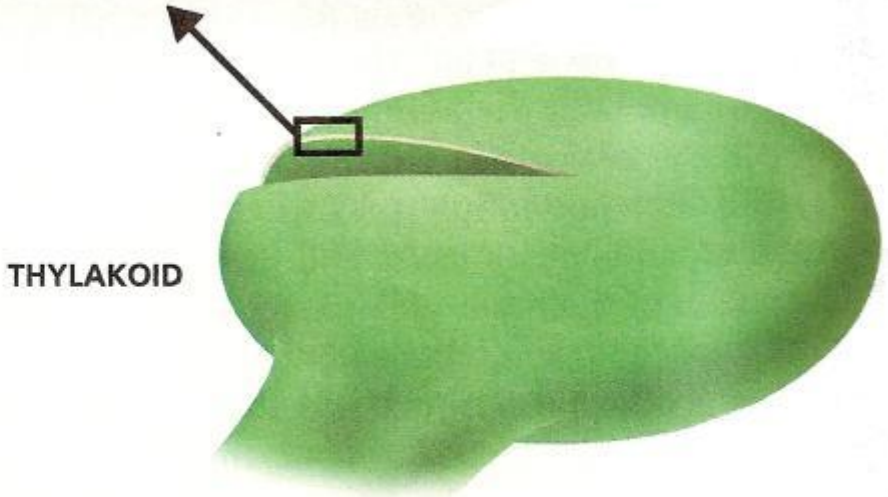
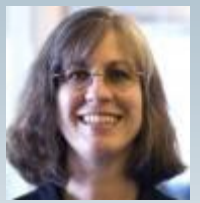


FIGURE 6-5

The light reactions take place in the thylakoid membrane and involve several steps. Step 1: Light excites electrons in chlorophyll *a* molecules of photosystem II. Step 2: These electrons move to a primary electron acceptor. Step 3: The electrons are then transferred along a series of molecules called an electron transport chain. Step 4: Light excites electrons in chlorophyll *a* molecules of photosystem I. As these electrons move to another primary electron acceptor, they are replaced by electrons from photosystem II. Step 5: The electrons from photosystem I are transferred along a second electron transport chain. At the end of this chain, they combine with $NADP^+$ and H^+ to make NADPH.



from Modern Biology, Holt, Rinehart, Winston page 114, FAIR USE



What are some great science texts you've used?

What are some good sources of science texts?

Let's build a resource list!

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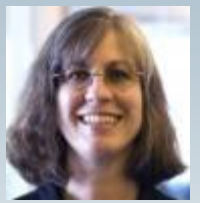
Online



Reading Apprenticeship Resources at readingapprenticeship.org

- Reproducible resources and teaching tools from *Reading for Understanding*
- readingapprenticeship.org/research-impact/videos/classroom/

RRSS Practice Guides to support science reading

- www.scienceandliteracy.org

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Why NOT Read in the Science Classroom?

Take-Aways: Pay Attention To..

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What you read (varied representations, trustworthy sources)

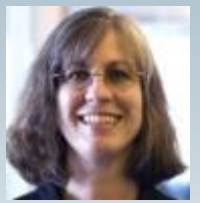
Why you read (foster inquiry purposes)

How you read (metacognitive, collaborative)

Who is doing the reading (engagement, support)

When you read (before, during, after, and *as* investigations)

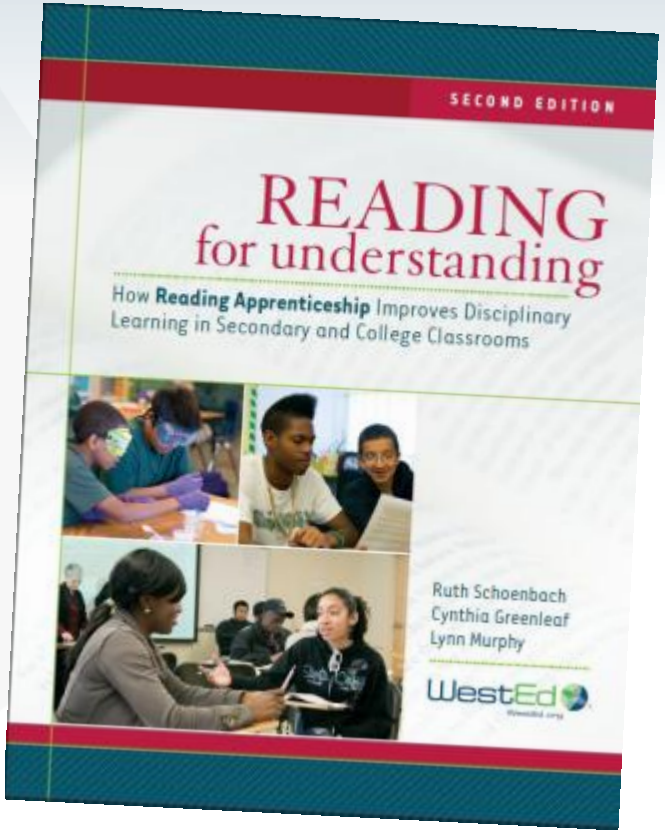
Supporting the range of learners in the classroom to make meaning of science with science texts



What was confusing?
How did you figure that out?

readingapprenticeship.org

Thank you



WestEd WEBINARS

Thanks to today's presenter!

Cynthia Greenleaf
WestEd

National Science Teachers Association

David Evans, Ph.D., Executive Director

Al Byers, Ph.D., Associate Executive Director, Services

NSTA Virtual Conference Team

Flavio Mendez, Senior Director, NSTA Learning Center

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Jeff Layman, Technical Coordinator, Web Seminars, SciGuides, and Help Desk

Stephanie Erickson, e-Learning Coordinator

Session Evaluation

- Click on the URL in the chat window
- Take as long as you need
  - After 2 minutes we'll come back for 15 minutes of live chat

NSTA VIRTUAL CONFERENCES
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Community Forums

- Join the discussion!
- Keep the conversation going, and post your in-depth comments about today's virtual conference at: http://learningcenter.nsta.org/discuss/

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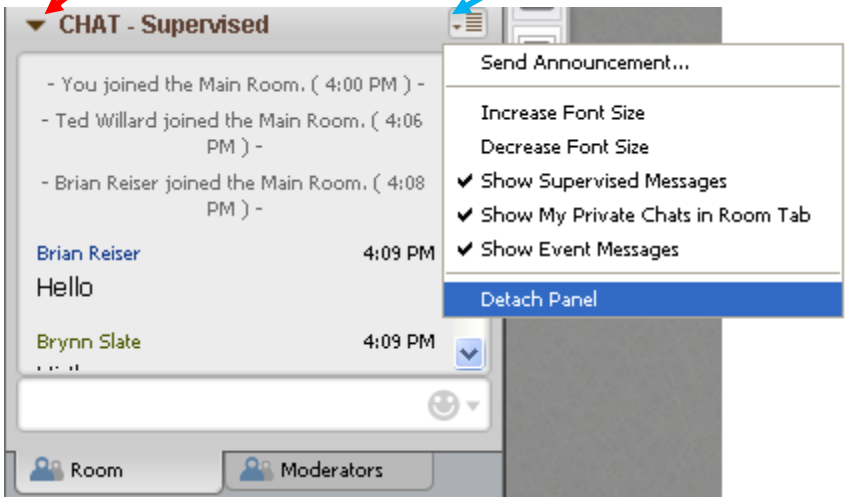
Live chat

- Type your questions and comments into the chat
- To share more in-depth comments, post later in community forums
- This session will end at:
  12:55 p.m. ET / 11:55 a.m. CT / 10:55 a.m. MT / 9:55 a.m. PT

Live chat

- Minimize or detach and expand chat panel



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Next steps

- Thank you for your participation in this session!
- The next session will begin at:
  1:10 p.m. ET / 12:10 p.m. CT / 11:10 a.m. MT / 10:10 a.m. PT
- To log in, please return to the launch page