Reframing Reading as an Inquiry Practice of Science

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WestEd
www.readingapprenticeship.org
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
Recent 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)
• Reading Apprenticeship Across the Disciplines (SEED)
Overview

• New standards offer an *unprecedented* opportunity to integrate literacy and science inquiry practices
• We can make reading science texts more like doing science
• 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
• Good models of “science inquiry with texts” point the way
• Resources abound
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)
- There is synergy, economy and necessity to doing many things at once
Next Generation Science Standards

Science and Engineering Practices –
Practices scientists use to investigate and build models and theories about the natural world
Practices engineers engage use to identify problems and design and test solutions

Crosscutting Concepts –
Generalizable concepts with broad applicability across science domains

Disciplinary Core Ideas –
Ideas with broad importance across multiple science and engineering domains
Key organizing concepts within or across science domains
NGSS Instructional Shifts

1. Focus on explaining phenomena or designing solutions to problems

2. Three-dimensional learning
   1. Disciplinary core ideas
   2. Science and engineering practices
   3. Crosscutting concepts

3. Coherence (i.e. learning progressions): build and apply ideas across time
Synergies in the Inquiry Practices of Science and Literacy

Science as Investigation to explain the natural and designed worlds:

- text-rich investigations (using data sets, science reports, science diagrams, graphs and models, micro/photography, simulations)

Literacy as Investigation to construct meaning with science texts:

- making sense of multiple representations, science conventions, and language complexity
Reframing Reading as an Inquiry Practice of Science

Engaging in making sense of science texts
(data sets, science reports, science diagrams, graphs and models, micro/photography, simulations)
in order to investigate and explain phenomena
A vision of what teaching reading as an inquiry practice of science might look like
MRSA Investigation

The emergence of methicillin resistant *Staphylococcus Aureus* requires an understanding of natural selection, adaptation of species, and human impact on micro-evolution.

Adolescents are at increased risk for contracting MRSA.

Safety precludes hands-on investigation of MRSA.

Text set: 14 texts, 2 videos from a range of reliable sources; multimodal representations.

Tasks: multiple opportunities to read, gather evidence, piece together explanatory models, and argue about their models.

- Infection
- Spread
- Evolution
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!
Resistance to the antibiotic Vancomycin rose dramatically over the 1990s in US hospital intensive care units.

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

**PIERCING QUESTIONS & IDEAS**

- How do antibiotics affect MRSA?
- If he hadn't sterilized the needle, would he still have gotten MRSA?
- Why would he pierce his lip if sick?
- 1st: How rare is MRSA?
  2nd: How common is MRSA?
- How do you get MRSA?
- Should people avoid taking antibiotics to prevent MRSA?
- Is MRSA a more complex version of Staph infection?
- Does MRSA affect joints to the point that they deteriorate?
- Why does he need surgery in knees & hips & the piercing is in lip?
- How did it spread to the legs & hips?

**Connie's Story Ideas & Q's**

- pus oozeed out of back
- Developed MRSA after surgery
- How does someone's body make a puddle of pus?
- What did she have in her vertebone?
- Is MRSA hard to detect?
- How did she contract it?
- Was it MRSA that caused her vertebone to deteriorate?
- 1st: What was pumping out of her back?
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

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

Bottom portion of Student 2’s model
Which of the NGSS Practices Did You See in This Text-Based Investigation?

<table>
<thead>
<tr>
<th>Practices</th>
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<td>Asking questions and defining problems</td>
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<td>Planning and carrying out investigations</td>
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<td>Analyzing and interpreting data</td>
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<td>Using mathematics and computational thinking</td>
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<tr>
<td>Constructing explanations and designing solutions</td>
</tr>
<tr>
<td>Engaging in argument from evidence</td>
</tr>
<tr>
<td>Obtaining, evaluating, and communicating information</td>
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Reframing Reading as an Inquiry Practice of Science

Readers of science
- draw on and build knowledge of Core Ideas
- draw on and build understanding of Cross-Cutting Concepts
- engage in multiple science practices while reading

Integration of literacy with science inquiry practices is promising for science and literacy learning
Common Core Aligned Standards for Literacy in Science and Technical Subjects

Through wide and deep reading ... of steadily increasing sophistication, students gain:

- a reservoir of knowledge, references, and images
- appreciation of the norms and conventions of the discipline
- understanding of domain-specific words and phrases
- attention to precise details
- capacity to evaluate intricate arguments, synthesize complex information, and follow detailed descriptions of events and concepts
Text-Based Investigations

1. Investigations into intriguing science phenomena (Berland & Reiser, 2009; Latour & Woolgar, 1986)

2. Sequence of texts offer a range of science representations (van den Broek, 2010)

3. Consequential tasks require reading to develop explanatory models and arguments (Cavagnetto, 2010; Ryu & Sandoval, 2012; Windschitl, Thompson, & Braaten, 2008)

4. Instructional supports – teacher guides, student interactive notebooks
   • foster reading for inquiry purposes (Schoenbach, Greenleaf & Murphy, 2012)
   • foster explanation and evaluation (Chin & Osborne, 2010; Passmore & Svoboda, 2012)
   • foster discussion and evidence-based argumentation to develop knowledge (Dueschl & Osborne, 2002; Von Aufschnaiter, Erduran, Osborne & Simon, 2008)
Theoretical Foundations
Nature and Practices of Science

• The teaching and learning of science **must better reflect the authentic practices of scientists** (Duschl, Schweingruber, & Shouse, 2007; Rutherford & Ahlgren, 1990).

• Scientists develop knowledge as they **build evidence for and against potential explanations** of phenomena (Berland & Reiser, 2009; Cavagnetto, 2010; Latour & Woolgar, 1986; Ryu & Sandoval, 2012).

• **Scientists argue** for the viability of their ideas by explicating **how well their explanatory models fit the data and relate to an established body of science principles and theory** (Bricker & Bell, 2008; Windschitl, Thompson, & Braaten, 2008).
Theoretical Foundations

Literacy in Science

- **Literacy** in its fundamental sense **plays a central knowledge-building role in science** (Norris & Phillips, 2003)

- Scientists read and write in varied semiotic forms and multiple modalities about the phenomena they study (Cromley, Snyder-Hogan, & Luciw-Dubas, 2010; Lemke, 1998; 1990; Waldrip, Prain, & Carolan, 2010; Yore, 2004)

- Scientists read for many purposes and these **purposes shape science reading processes** (Cervetti & Barber, 2008; Goldman et al., 2016; Goldman & Bisanz, 2002; Tenopir & King, 2004)
Theoretical Foundations
Disciplinary Literacy

• Disciplinary literacy instruction means “learning how to read, think about, write, communicate, and use information like each discipline’s experts” (Fang, 2012)

• Disciplinary literacy instruction must center on and teach students to navigate the processes of inquiry characteristic of each discipline (Moje, 2015)
Empirical Evidence Demonstrates that Integrating Literacy and Science Benefits Students’ Literacy and Science Learning

Integrating science and literacy (Greenleaf, et al., 2011; McNeill & Krajcik, 2011; Miller & Calfee, 2004; Osborne, 2002; Romance & Vitale, 2001; Webb, 2010; Yore, 2004)

Writing in multiple modalities (Putra & Tang, 2016; Tang & Moje, 2010)

• Representing to Learn - Tytler, Prain, Hubber, & Waldrip, 2013)
• Science Writing Heuristic for Argument-Based Inquiry - Gunel, Hand, & Gunduz, 2006; Hand & Choi, 2010)

Integrating science investigations and reading

• Seeds of Science, Roots of Reading – Cervetti, et al., 2006; Cervetti & Pearson, 2012
• Adapted Primary Literature - Falk & Yarden, 2009, 2011; Koomen, Weaver, Blair, & Oberhauser, 2016; Norris, Stelnicki, & de Vries, 2012; Phillips & Norris, 2009;
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
Students do not enter upper elementary, middle or high school with a command of the literacy skills and practices necessary to engage in these science practices (NAEP 2015).

Regardless of previous achievement, students are capable of learning advanced literacies (de Schonewise & Klingner, 2012; Greenleaf, Schoenbach, Cziko, & Mueller, 2001; Lee & Spratley, 2010).
Opportunity to Learn Disciplinary Literacy in Science

• **Students need time and support** to learn to read science texts for the purpose of science investigation, but…

• **Close reading and investigation** with science texts (and hands on science investigations themselves) are **rare in science** instruction (Cervetti & Barber, 2008; Duschl et al., 2007; Fisher, 2009; Greenleaf & Valencia, 2017; Krajcik & Sutherland, 2010; Litman, et al., 2017).
Common Instructional Adaptations when Students are Inexperienced Science Readers

✓ Avoid using science texts
  • Use powerpoints, videos, demonstrations and lectures to get the information across
  • Look for really easy texts to use
  • Use concept attainment tasks (manipulatives) rather than texts
  • Use hands-on investigations without texts

✓ Do the reading work for students who struggle
  • Read science texts to students and explain what they mean
  • Have the strong readers in class read aloud to the others

✓ Support students to learn to read science texts independently
  • Model and support students to practice science reading processes
  • Have students work together to figure texts out
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
Science Texts Represent Ideas through Multiple Means

This year's dominant strain is especially virulent

- Type A, subtype H3N2 tends to strike young children and older people more than anyone else. In recent weeks, though, a B-type strain has been surging. That means the flu season is far from over, as the B strain now spreads through communities. But the good news is that strain isn't as destructive as A-H3N2. Plus, this year's flu vaccine is much better at preventing the B-type strain than A-H3N2.

Positive test results for:
- A (H3) strain
- A (2009 H1N1) strain
- B strains
- Other strains

Note: Data based on positive test results reported to the CDC from U.S. public health laboratories.
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.
Science Uses Words in Specialized Ways

Define the following terms:

1. Gravity
   Seriousness

2. Magnetism
   Having charisma

3. Light
   Not weighing much

4. Heat
   What gangsters pack

The idea isn’t for us to test each other, Peter.

What do you 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.
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).
Why Read in the Science Classroom?

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

<table>
<thead>
<tr>
<th>Scientists</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Situate their research</td>
<td>Provide context</td>
</tr>
<tr>
<td>Search for information about topics of interest</td>
<td>Deliver content</td>
</tr>
<tr>
<td>Learn about methods they might use</td>
<td>Provide models</td>
</tr>
<tr>
<td>Learn about other scientists’ findings and critique their conclusions; use existing data for new investigations</td>
<td>Support investigations of phenomena</td>
</tr>
</tbody>
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Provide Context

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

- model inquiry processes
- model nature of science
- model literacy processes
Support Investigations of Phenomena

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

Seeds of Science, Roots of Reading, scienceandliteracy.org
Support Investigations of Phenomena

• provide data for students to interpret

Jess Makes Hair Gel
by Jacqueline Barber • Illustrated by Marsha Winborn

Jess’s Substance Table

<table>
<thead>
<tr>
<th>Substance</th>
<th>Looks shiny</th>
<th>Makes spikes</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shampoo</td>
<td>yes</td>
<td>no</td>
<td>foamy</td>
</tr>
<tr>
<td>Shaving cream</td>
<td>no</td>
<td>yes</td>
<td>very foamy</td>
</tr>
<tr>
<td>Egg whites</td>
<td>yes</td>
<td>no</td>
<td>too thick</td>
</tr>
<tr>
<td>Corn syrup</td>
<td>no</td>
<td>no</td>
<td>too thin</td>
</tr>
<tr>
<td>Lime gelatin</td>
<td>yes</td>
<td>yes</td>
<td>green</td>
</tr>
<tr>
<td>Glue stick</td>
<td>no</td>
<td>yes</td>
<td>smells like lime</td>
</tr>
</tbody>
</table>

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?
Deliver Content

- deliver science information
- provide information and explanations about unobservable phenomena
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, 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
Diagram
Detective: What Does an Arrow Mean?

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.
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
Pam Moore’s 7th Grade Life Science Class, 2015

Cesar Chavez Middle School, New Haven School District, CA

Diverse student population

- 55% eligible for free and reduced lunch
- 57% Latina/o, 12% Filipina/o, 12% Asian
- 22% English Learners, 35% reclassified
- District-wide Literacy Initiative

Reading Apprenticeship professional learning cohorts 2012 - 2015
Woolly Mammoth Resurrection, "Jurassic Park" Planned

Stefan Lovgren
for National Geographic News
April 8, 2005

A team of Japanese genetic scientists aims to bring woolly mammoths back to life and create a Jurassic Park-style refuge for resurrected species. The effort has garnered new attention as a frozen mammoth is drawing crowds at the 2005 World Exposition in Aichi, Japan. The team of scientists, which is not associated with the exhibit, wants to do more than just put a carcass on display. They aim to revive the Ice Age plant-eaters, 10,000 years after they went extinct. Their plan: to retrieve sperm from a mammoth frozen in tundra, use it to impregnate an elephant, and then raise the offspring in a safari park in the Siberian wild.
View 7th grade life science video on
www.readingapprenticeship.org/impact-stories/videos/classroom/
What did you notice?

How did the teacher:

• Invite students to share puzzlement about reading and about science?
• Engage students to make meaning of complex text?
• Build connection between reading and science investigations?
Reframing Reading as an Inquiry Practice of Science

- Surfacing confusions about the mechanism
- Citing evidence from the text
- Asking questions about the mechanism
- Making conjectures and alternative conjectures
- Co-construction of meaning
- Using the conventions of science communication
- Understanding the nature of science
- Engagement!
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
Teacher mediation supports and orchestrates students’ reading, modeling, and argumentation practice (Gibbons, 2003; McNeill & Krajcik, 2008)

Teacher mediate students’ opportunities to learn
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
Time for 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?
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

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- Gradual Release of Responsibility
Construct a “Living” Reading and Reasoning 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?
New Haven Unified School District Biology Teacher and Instructional Coach Abby Noche

Classroom “Shower Curtain” captures students’ ideas about what works well in science reading, thinking, and discussion over time.
Word Detective: What Does an Unfamiliar Word or Word Use Mean?

The Word Wall grows organically from student nominations in Abby Noche’s Biology classroom in New Haven Unified School District.
Metacognitive Dual-Entry Logs and Journals

EVIDENCE (I saw/noticed/read)  INTERPRETATION (I thought/wondered)
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 Support 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 …?
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?
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?

Testing
• According to the text, how does _____ lead to ______?
• What causes ________?
• How many _____ of _____ are there?
• If you add _____, what happens?
Grades and Assessment that Value 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
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
Why Read in the Science Classroom?

Resources abound
Science news reporting, trustworthy websites, trade journals, trade books, and even the textbook
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
- Textbooks (repurpose for inquiry, use excerpts)
http://www.education.noaa.gov/Freshwater/Water_Cycle.html
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.

**Solar eclipse:**
Sun, Moon, and Earth line up, with the Moon in the middle.

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

**Lunar eclipse:**
Sun, Earth and Moon line up, with Earth in the middle.

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).

**How often can we see a Venus transit?**

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

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.
Text-Based Investigation Modules

Middle School

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

- Methicillin Resistant Staph Aureus module and Malaria Pre/post assessment – Life Science
- Reading Models Mini-Unit, Life Science
- Homeostasis – Life Science
- Cell Theory Text Set – Life
- Teacher developed modules
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<td>Tasks and activities</td>
</tr>
<tr>
<td>Texts</td>
</tr>
<tr>
<td>Instructional supports</td>
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<tr>
<td>Annotations that reflect teachers’ rationales, expectations, and experiences with different parts of the modules</td>
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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.
Why NOT Read in the Science Classroom?

Take-Aways: Pay Attention To...

• What you read (varied representations, trustworthy sources, phenomena-linked)
• 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
Online

Reading Apprenticeship Resources at readingapprenticeship.org
  • Reproducible resources and teaching tools from *Reading for Understanding*
    • readingapprenticeship.org

Text-Based Investigation Modules
  • www.projectreadi.org

SSRR Practice Guides to support science reading
  • www.scienceandliteracy.org
What was confusing?
How did you figure that out?

Thank you

www.readingapprenticeship.org