

# **Disciplinary Literacy in Science and Mathematics: Using Literacy to Unlock Content Knowledge**

**Rachel Lang Daniels**

February 19, 2020



**educational service center**  
*of Central Ohio*



# Contact Information

Rachel Lang Daniels  
Adolescent Literacy Specialist  
SST 11, ESC of Central Ohio

[Rachel.Daniels@escoco.org](mailto:Rachel.Daniels@escoco.org)

614.542.4188



# Participant Outcomes



To understand the concept of disciplinary literacy as outlined in Ohio's Plan to Raise Literacy Achievement

To explore how knowledge is constructed within the disciplines

To discuss practices in order to implement disciplinary literacy in Science and Mathematics



# Opening Reflection

## What is Disciplinary Literacy?

Disciplinary literacy moves beyond the common strategies used across all content areas and focuses on the unique strategies experts use to engage with text in an academic discipline.

(Shanahan, 2012)

- 
- Create
  - Communicate
  - Evaluate



# Adolescent Literacy



# Scarborough's Reading Rope

## STRANDS OF EARLY LITERACY DEVELOPMENT

### LANGUAGE COMPREHENSION

BACKGROUND KNOWLEDGE  
(facts, concepts, etc.)

VOCABULARY  
(breadth, precision, links, etc.)

LANGUAGE STRUCTURES  
(syntax, semantics, etc.)

VERBAL REASONING  
(inference, metaphor, etc.)

LITERACY KNOWLEDGE  
(print concepts, genres, etc.)

### WORD RECOGNITION

PHONOLOGICAL AWARENESS  
(syllables, phonemes, etc.)

DECODING (alphabetic principle,  
spelling-sound correspondences)

SIGHT RECOGNITION  
(of familiar words)

We now know that phonemic awareness is a language ability  
(Werker & Tees, 2002; Kuhl et al., 2005; Kenner et al., 2017)



increasingly strategic

increasingly automatic

**SKILLED READING:**  
Fluent execution and coordination of word recognition and text comprehension.

Hollis Scarborough's Reading Rope, 2001





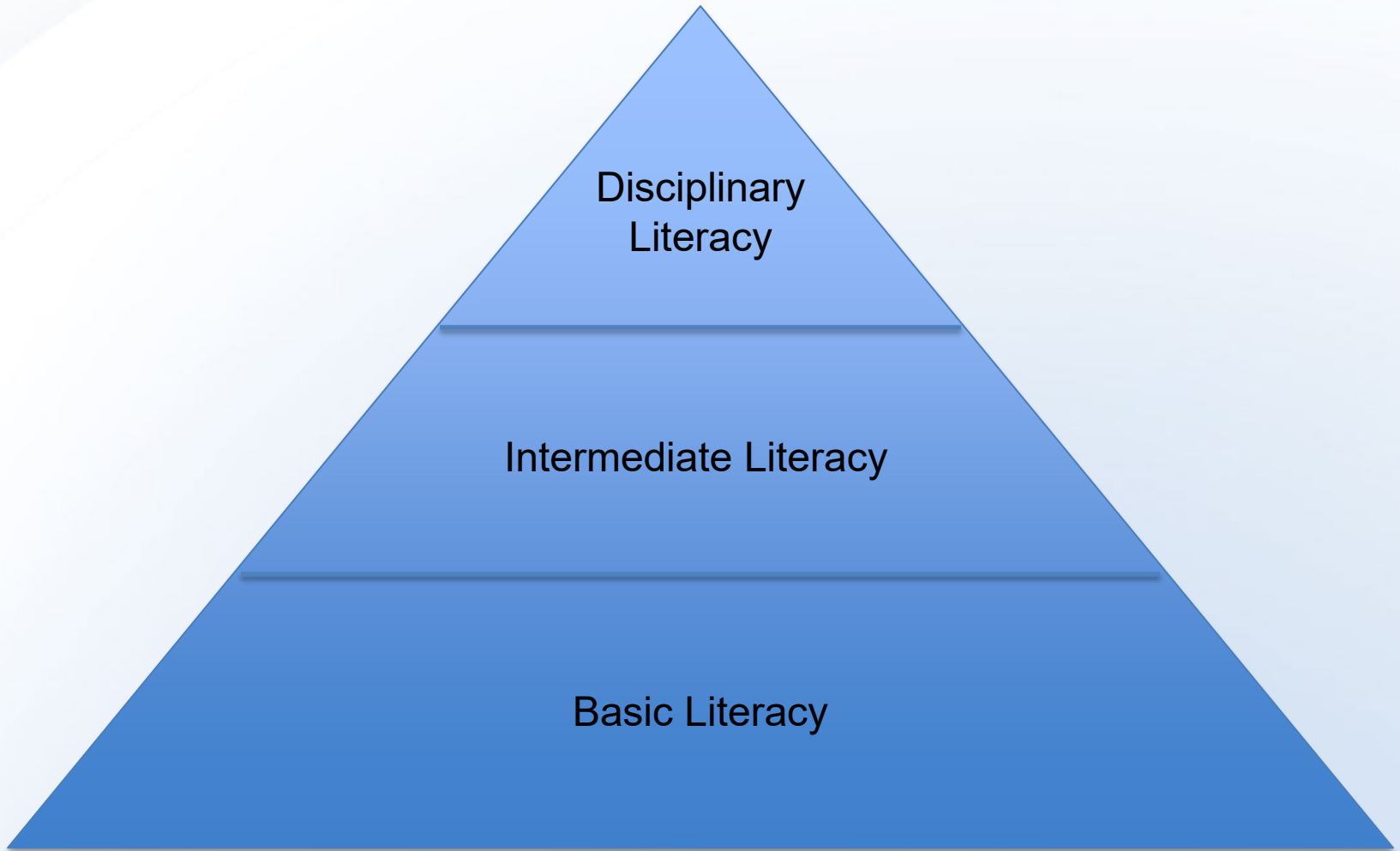
# Evidence-Based Practices

Provide explicit vocabulary instruction	Strong Evidence
Provide direct and explicit comprehension strategy instruction	Strong Evidence
Provide opportunities for extended discussion of text meaning and interpretation	Moderate Evidence
Increase student motivation and engagement in literacy learning	Moderate Evidence
Make available intensive and individualized interventions for struggling readers that can be provided by trained specialists	Strong Evidence

IES Practice Guide, 2008



# Increasing Literacy Specialization

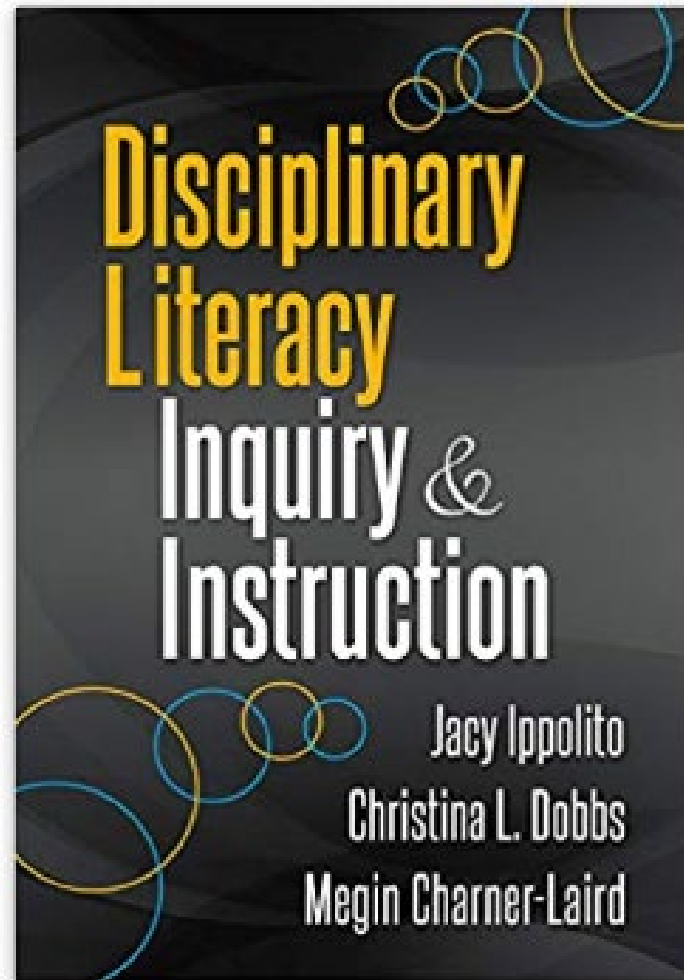


Shanahan (2008)





# Learning from the experts



Do students read every day in class?

Do students think critically and solve problems?

Do students write every day in class?

How to create a culture of schoolwide DL

Do students collaborate to find, evaluate, and apply new learning?

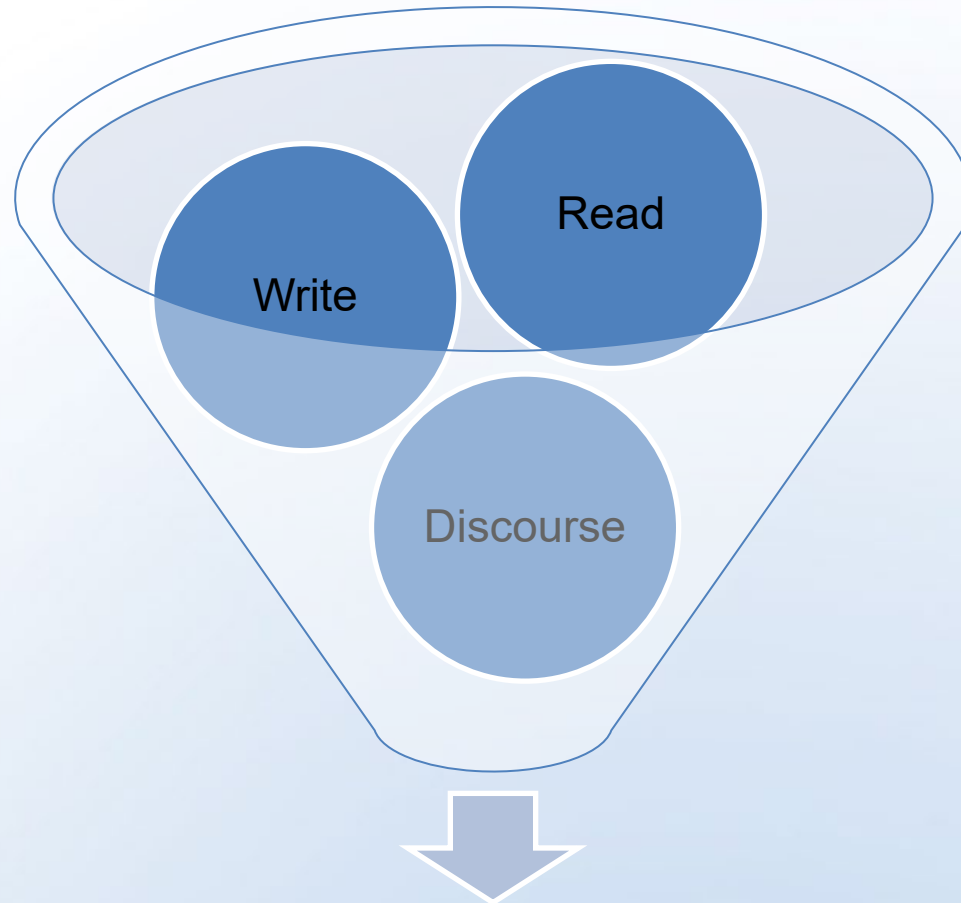
Do students inquire by asking more questions than they answer?

Do students hear complex text read aloud in every discipline?

from *Disciplinary Literacy in Action*  
by Releah Lent (2019)



In Every Class, Every Day



**Disciplinary Literacy**



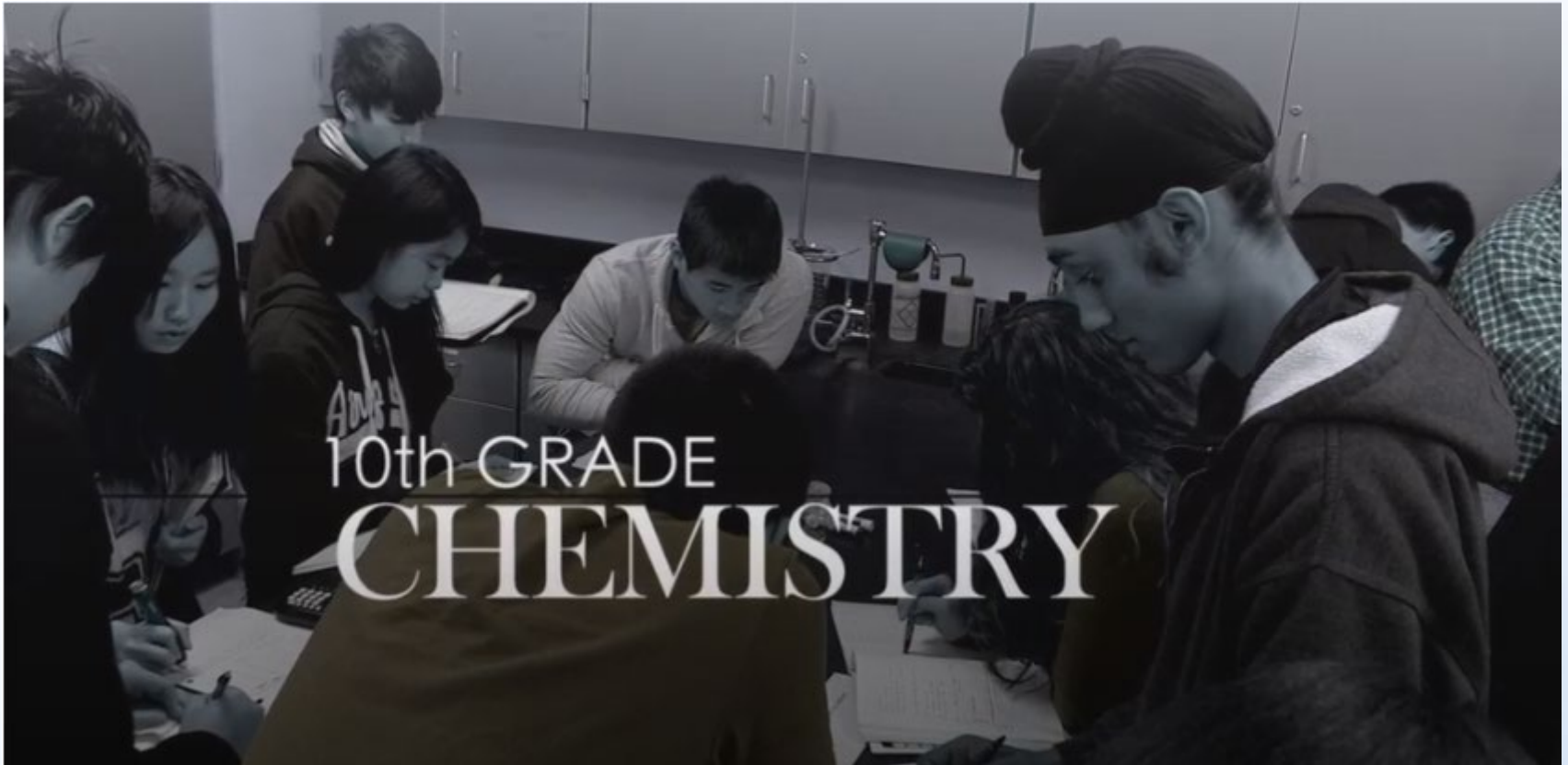
# Discussion

In what ways do Scientist and Mathematicians create, communicate and evaluate information?

What texts are read? What kinds of writing is utilized? In what ways are communication skills critical in these disciplines?



# Supporting Claims with Evidence and Reasoning



# Reflect on Science



## Disciplinary Literacy Approaches

**Introduction:** This document provides examples of discipline-specific approaches and resources<sup>1</sup> as related to disciplinary literacy.

Discipline	Approach	Practices	Vocabulary Examples	Resources
<b>Social Studies</b>	Historians consider multiple perspectives when reading and writing historical accounts and arguments.	<ul style="list-style-type: none"> <li>• Notice source and context.</li> <li>• Analyze accounts that present conflicting interpretations.</li> <li>• Reference language of causality and chronology</li> <li>• Determine how ideas are communicated.</li> <li>• Approach texts specific to purpose and text source.</li> <li>• Writing argumentative texts using accurate historical data.</li> </ul>	<ul style="list-style-type: none"> <li>• Primary</li> <li>• Secondary</li> <li>• Source</li> <li>• Causality</li> <li>• Chronology</li> </ul>	<p>Literacy in the Disciplines: A Teacher's Guide for Grades 5-12: Chapter 2, pp. 30-35. (Wolsey, Lapp, 2017)</p> <p>Disciplinary Literacy Strategies in Content Area Classes (Shanahan, 2015, p. 8-15)</p> <p>Stanford History Education Group (SHEG): Historical Thinking Chart</p> <p>Thinking Like a Historian (Wineburg, 2010)</p>
<b>Mathematics</b>	<p>Mathematicians read carefully, evaluating the meaning of each word or symbol and apply logic to their reading.</p> <p>Mathematicians use precise vocabulary to describe and defend their work.</p>	<ul style="list-style-type: none"> <li>• Learn accurate definitions</li> <li>• Reread</li> <li>• Read equations with appropriate directionality</li> <li>• Detect errors</li> <li>• Read for evidence and interpret visuals</li> <li>• Identify representation</li> <li>• Express regularity in repeated reasoning</li> </ul>	<ul style="list-style-type: none"> <li>• Difference</li> <li>• Distribution</li> <li>• Properties</li> <li>• Expression</li> <li>• Terms</li> <li>• Factorization</li> <li>• Binomials</li> </ul>	<p>Literacy in the Disciplines: A Teacher's Guide for Grades 5-12: Chapter 2, pp. 19-23. (Wolsey, Lapp, 2017).</p> <p>Disciplinary Literacy Strategies in Content Area Classes (Shanahan, 2015, p. 3-5)</p> <p><a href="#">A Literature Review on Disciplinary Literacy: How do Secondary Teachers Apprentice Students into Mathematical Literacy? (Hillman, 2013).</a></p> <p><a href="#">Tennessee Math Standards, pp. 9-12</a></p>

<sup>1</sup> Reference to any resource, organization, activity, product, or service does not constitute or imply endorsement by the Tennessee Department of Education.



# Discussion--Science

At your table discuss your observations from the video as well as the approaches, practices and vocabulary noted in the Disciplinary Literacy Approaches document.





# Thinking like a Mathematician

a closer look  
**INSIDE**  
the **CLASSROOM**

**THINKING LIKE A  
MATHEMATICIAN**



# Reflect on Mathematics



## Disciplinary Literacy Approaches

**Introduction:** This document provides examples of discipline-specific approaches and resources<sup>1</sup> as related to disciplinary literacy.

Discipline	Approach	Practices	Vocabulary Examples	Resources
<b>Social Studies</b>	Historians consider multiple perspectives when reading and writing historical accounts and arguments.	<ul style="list-style-type: none"> <li>Notice source and context.</li> <li>Analyze accounts that present conflicting interpretations.</li> <li>Reference language of causality and chronology</li> <li>Determine how ideas are communicated.</li> <li>Approach texts specific to purpose and text source.</li> <li>Writing argumentative texts using accurate historical data.</li> </ul>	<ul style="list-style-type: none"> <li>Primary</li> <li>Secondary</li> <li>Source</li> <li>Causality</li> <li>Chronology</li> </ul>	<p>Literacy in the Disciplines: A Teacher's Guide for Grades 5-12: Chapter 2, pp. 30-35. (Wolsey, Lapp, 2017)</p> <p>Disciplinary Literacy Strategies in Content Area Classes (Shanahan, 2015, p. 8-15)</p> <p>Stanford History Education Group (SHEG): Historical Thinking Chart</p> <p>Thinking Like a Historian (Wineburg, 2010)</p>
<b>Mathematics</b>	<p>Mathematicians read carefully, evaluating the meaning of each word or symbol and apply logic to their reading.</p> <p>Mathematicians use precise vocabulary to describe and defend their work.</p>	<ul style="list-style-type: none"> <li>Learn accurate definitions</li> <li>Reread</li> <li>Read equations with appropriate directionality</li> <li>Detect errors</li> <li>Read for evidence and interpret visuals</li> <li>Identify representation</li> <li>Express regularity in repeated reasoning</li> </ul>	<ul style="list-style-type: none"> <li>Difference</li> <li>Distribution</li> <li>Properties</li> <li>Expression</li> <li>Terms</li> <li>Factorization</li> <li>Binomials</li> </ul>	<p>Literacy in the Disciplines: A Teacher's Guide for Grades 5-12: Chapter 2, pp. 19-23. (Wolsey, Lapp, 2017).</p> <p>Disciplinary Literacy Strategies in Content Area Classes (Shanahan, 2015, p. 3-5)</p> <p><a href="#">A Literature Review on Disciplinary Literacy: How do Secondary Teachers Apprentice Students into Mathematical Literacy? (Hillman, 2013).</a></p> <p><a href="#">Tennessee Math Standards, pp. 9-12</a></p>

<sup>1</sup> Reference to any resource, organization, activity, product, or service does not constitute or imply endorsement by the Tennessee Department of Education.



# Discussion--Mathematics

At your table discuss your observations from the video as well as the approaches, practices and vocabulary noted in the Disciplinary Literacy Approaches document.



# Writing in the Disciplines

Scientists	Mathematicians
Compose in phrases, bullets, graphs, or sketches	Explain, justify, describe, estimate or analyze
Use precise wording	Use representations
Favor passive voice	Seek precision
seek exactness over craft	Utilize real-world situations
Communicate in a systematic format	Communicate ideas clearly
Distinguish facts from opinions	Draw conclusions
Generate questions	Use symbols and abstractions
Provide details, narratives and causal effects	Include reasons and examples (p. 278)
Use technical language (p. 282)	

*Disciplinary Literacy in Action*  
Lent and Voight (2019)



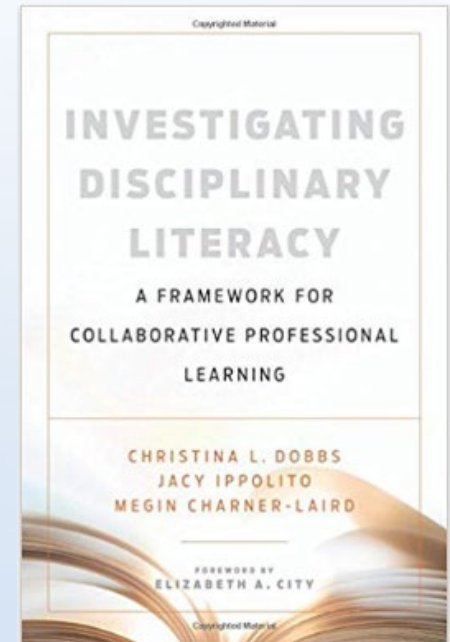
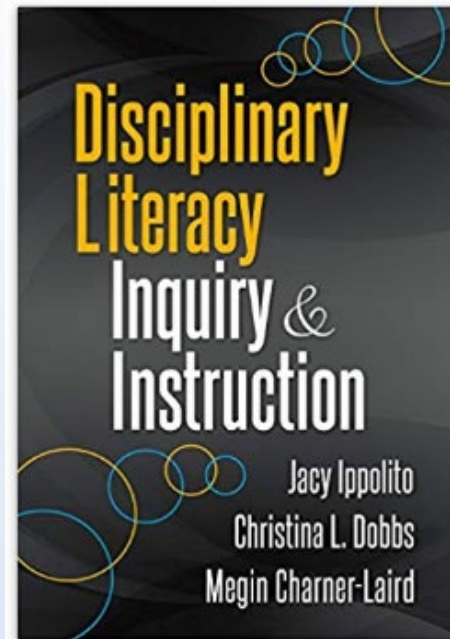
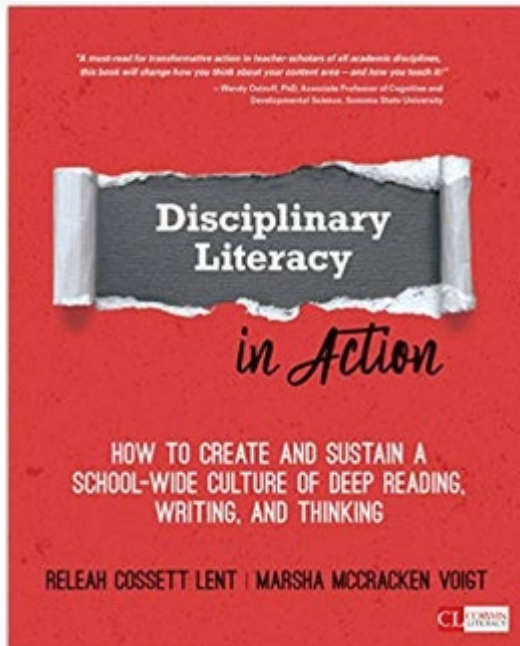
# Closing Reflection



**Confirm or correct what you know about disciplinary literacy. Share with a colleague.**



# Resources to Explore



# Contact Information

Rachel Lang Daniels  
Adolescent Literacy Specialist  
SST 11, ESC of Central Ohio

[Rachel.Daniels@escoco.org](mailto:Rachel.Daniels@escoco.org)

614.542.4188







[www.facebook.com/escofcentralohio](http://www.facebook.com/escofcentralohio)



[twitter.com/ESCCentralOhio](https://twitter.com/ESCCentralOhio)



[www.linkedin.com/company/  
educational-service-center -of-central-ohio](http://www.linkedin.com/company/educational-service-center-of-central-ohio)

