Disciplinary Literacy in Science

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Objectives

1. Examine the benefits of disciplinary literacy for science teaching & student learning
2. Learn science-specific literacy strategies (Grades 6-12)
3. Discuss a disciplinary literacy framework for science teaching and learning

Science

- Refocus disciplinary literacy instruction from an emphasis on strategies for comprehension toward an emphasis on practices for disciplinary inquiry…(Moje et al., 2010).
- A shift from:
  - "I need some vocabulary or comprehension strategies."
  - "How can I teach my students to use visual information (e.g., charts, graphs, diagrams) of the concept to understand its definition? (Math)
- Teachers model and develop habits of thinking, knowing, and doing per discipline.
- Tailored, discipline-specific, instruction that develops both content and literacy.

Science

- Science is the process of discovering how the world works.
  - Science is not just a collection of facts & theories
    - Facts & theories are important, but
      - Science is concerned about uncovering these concepts
- Facts & theories will change but the process of ***questioning*** what is currently accepted & ***looking*** for the undiscovered is constant in science.
- Ideas are ***accurate*** if they are supported by ***facts/evidence.***
  - **This is also aligned with the common core standards and the disciplinary literacy learning framework.**

What Do Scientists Do?

80% of their time is devoted to reading and writing

(Palincsar & Magnusson. 2000)

Science Texts

- The ability to read science materials **requires** skills that:
  - allow students to read procedural information;
  - graphical displays including maps, charts, data tables, graphs, diagrams, and drawings; and,
  - mathematical expressions.
- One of the challenges science teachers face is determining how to foster these skills without sacrificing inquiry or content.

Science Text Patterns

- Classification
- Process-description
- Factual-statement
- Problem-solution
- Experiment-instruction
- Combination

Science Content and Process

Science Content: Facts, formulas, concepts, theories

Science Process: Scientific method, inquiry, discourse

- Science Trends & Issues
  - Trend 1: "Hands-on" science: focus on student-driven discovery vs. teacher-led, passive learning
  - Call to inquiry resulted in leaving out…critical reasoning, analysis of evidence, development of models, and written/oral discourse associated with constructing and evaluating arguments and explanations
  - All important to inquiry, but downplayed when "hands-on" activities are not carefully designed or scaffolded.

Science Trends and Issues

Trend 2: treating scientific methodology as separate from content

- The scientific method being treated as a linear, scripted process vs.
- Scientific inquiry—reasoning; implications about models & theories; framing questions & hypotheses so they are productively investigated; systematically analyzing & integrating data to serve as evidence to evaluate claims; communicating & critiquing ideas in scientific community

Students who are proficient in science:

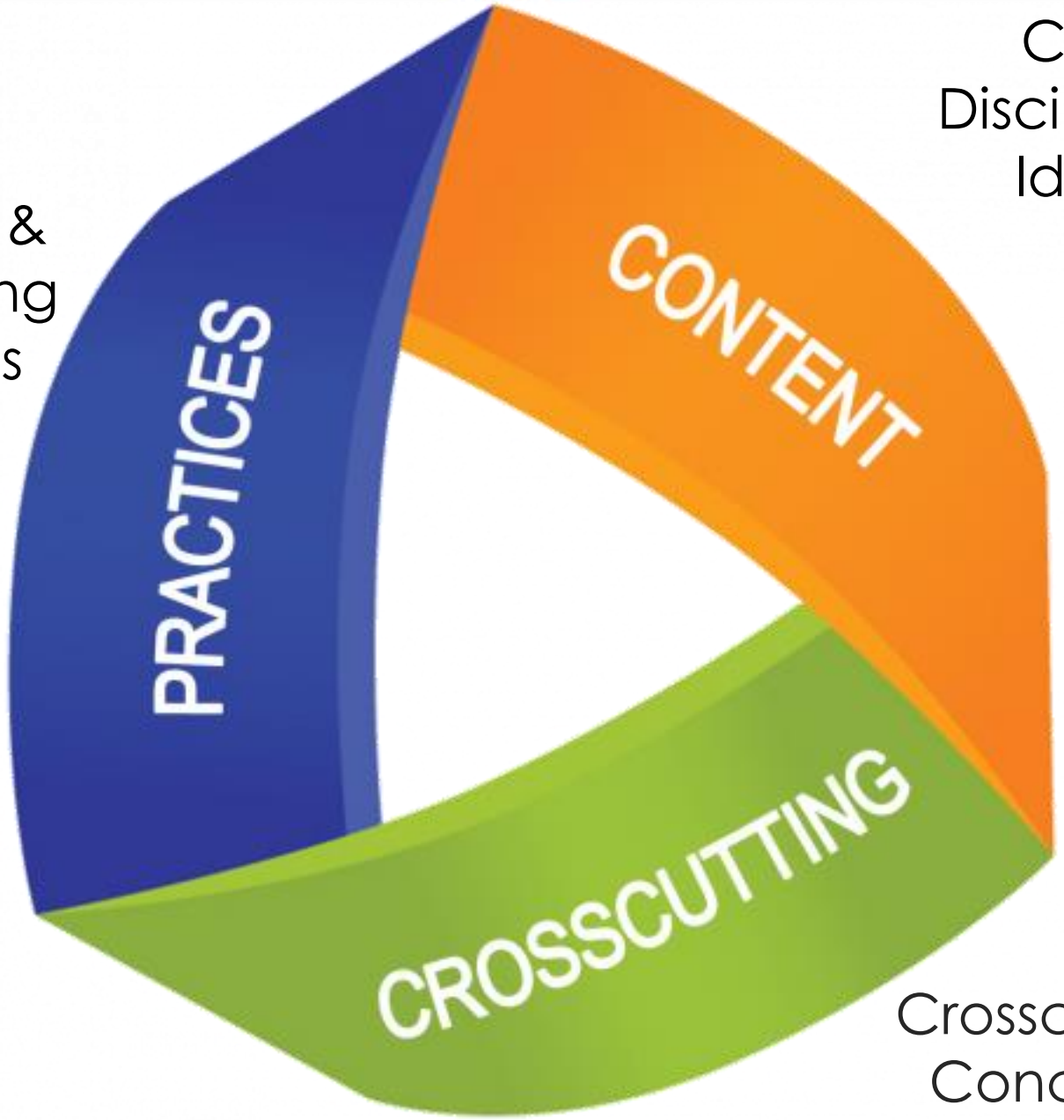
- Know, use, and interpret scientific explanations of the natural world
- Generate and evaluate scientific evidence and explanations
- Understand the nature and development of scientific knowledge
- Participate in scientific practices and discourse.

Science Framework

Scientific "Practices"

- The essential integration of disciplinary knowledge and skills in action that result in deep learning.
- The variety of activities, competencies, and dispositions involved in doing science, including:
  - Habits of reasoning, discourse norms of communities & institutions, attitudes, values, and recognition of multiple methodologies: observation, field work, and modeling in addition to laboratory experiments.
  - Including modeling, communication, & critique

Scientific & Engineering Practices



Core Disciplinary Ideas

Crosscutting Concepts

8 Scientific Practices (NGSS, NRC)

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Subject-Matter Expectations: Science

- Students are expected to read, comprehend, discuss, express, produce, and reflect upon complex, discipline-specific texts.
- Students to understand content knowledge at a **deep level.**

Students need to learn and understand the big ideas and concepts from class that they will continue to use, rather than just memorize facts.

- What big ideas and concepts students need to learn and understand for the unit of study?
- How will you teach them to make connections between these ideas and with other concepts they have learned so far?
- How will you teach them to make connections between these ideas (and use) and other everyday concepts?

Vocabulary Development: What to Avoid

- Copying definitions
- Mere memorization
- Absence of classroom talk. Why?
  - Research supports the use of rich discussions of text(s) because discussion
    a. Allows students to participate as both speakers and listeners
    b. Invites students to organize their thoughts (especially if they have to explain words to someone else)
    c. Promotes accuracy and monitoring of one's understanding
    d. Offers opportunities for repeated exposure to words which in turn, facilitate vocabulary learning (Barron & Melnik, 1973).

Benefits of Disciplinary Literacy

- Higher teacher expectations
- Rigorous tasks and dense instruction
- Prepares students for college and career demands
- Higher student engagement with learning tasks
- Cognitive stamina, persistence
- Teachers enjoy disciplinary relevance

Disciplinary Literacy Helps Students to…

- Master academic content
- Engage in expanding their knowledge
- Think critically & in discipline-specific ways
- Solve complex problems
- Work collaboratively
- Learn how to learn (metacognition)

What Does Inquiry Look Like in Science?

- Make observations & form hypothesis
- Ask scientifically oriented questions
- Inquiry, priority to evidence, develop and evaluate explanations that address questions in the field
- Collect, represent, analyze, and interpret data
- Draw logical & verifiable conclusions (lots of attention on evidence)
- Critical analysis of claims, procedures, errors, data, mathematical data and figures, etc.
- Discuss and compare ideas with others, communicate results & collaborate with others

From General to Discipline-Specific Literacy Strategies

General Strategies	Cross Disciplinary Strategies	Sample Discipline Specific Strategies
Predict	Venn Diagram	History—Examining the Argument
Question	KWL	Math—Problem-Solution
Summarize	Reciprocal Teaching	Science—Claim-Evidence-Reasoning
Clarify	REAP (read, encode, annotate, ponder)	English Language Arts—Viewpoint Analysis
Interpret	Frayer Model	
Evaluate	Cornell Notes	

Examine Science-Specific Strategies

1. Read like a scientist

2. Magnet word

3. Claim-Evidence-Reasoning

Message to Content Area Teachers

- Your content knowledge is needed.
- Your knowledge about teaching arts, ELA, science, social studies, and technical subjects, etc. to all students is needed more than ever!
- Content, thinking, & literacy need to develop **in tandem!**
- Do you teach science as inquiry?
- Do you teach discipline-specific **habits of mind?**
- The CCSS require the student to **read like a detective** and **write like an investigative reporter.**

Shifts Caused by the CCSS (and Supported by DL)

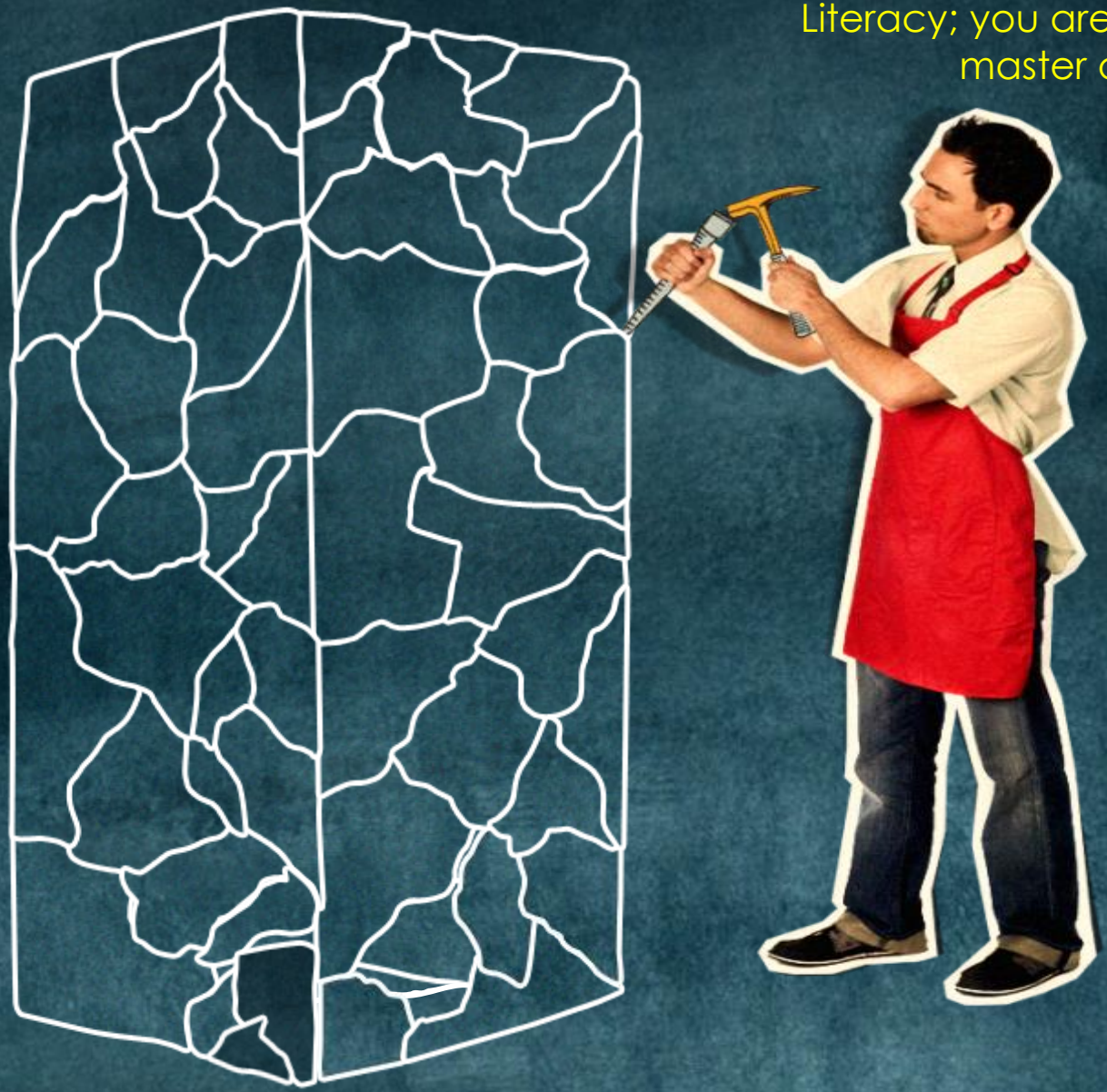
- Perspectives, roles, time, instruction, learning framework, assessment
  - School culture shifts
  - Learning expectations—learning as apprenticeship
  - Role of language and literacy
  - Role of reading and writing
  - Role of text (curriculum, text selection, the teacher's edition)
  - Role of deep learning
  - Roles of teacher and student
  - Instruction—how learning takes place
  - Use of classroom time
  - Assessment
  - Shared Accountability

What Does it Look Like in Practice in Every Classroom?

- Engaged students
- Noisy classrooms (student collaboration; t-student interactions)
- Large amounts of close, purposeful, rigorous, and critical reading and rereading
- Rigorous teaching & learning
- Thoughtful environment (students take time to reflect and respond; evidence-based discussions))
- Much teacher modeling, facilitation, & monitoring of student learning
- Writing & technology

We can make massive strides with a disciplinary literacy learning framework

Get rid of excess "marble"… or fears about the CCSS and Disciplinary Literacy; you are a true "artist" and a master of your craft.



Sculpting was Michelangelo's true love just like teaching is ours. When he looked at a piece of marble, he saw the statue already inside the marble. Then he just had to chip away anything that wasn't the statue so we could see what he saw. *Get together with your colleagues and decide on what to chisel away.*

Wrap-Up Questions

"The world as we have created it is a process of our thinking. It cannot be changed without changing our thinking."
—Albert Einstein

Thank You!

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Disciplinary Literacy: The key to developing all students' literacy, content knowledge, and thinking skills.