Discipline-Specific Literacy

Module 3

Mathematics

Discipline-Specific Literacy

5-3-1.

On your own, identify 5 key ideas, principles or facts.
In pairs, share your list and come up with your top 3.
At your table, or with another pair, identify 1 “MVP” (most valuable point)

Essential Questions

- How can utilizing discipline specific reading strategies to enhance the understanding of all students within the mathematics discipline?
- How does literacy across the disciplines prepare students for their next educational challenges?
- How do we prepare students to *Read Like Mathematicians?*

Why Literacy is a Shared Responsibility

8th Grade: Only one third were able to perform at a proficient level involving more sophisticated disciplinary comprehension expectations. Only 3% scored advanced.

12th Grade: Only 5% scored at advanced levels, able to read specialized and complex texts.

NAEP, 2009

Why Literacy in Math?

"21st Century literacy demands that students need to be proficient readers in a variety of types of texts. Students need frequent opportunities to read and write and quality instruction as part of their learning experience."

- Irvin, Judith, Meltzer, Julie & Dukes, Melinda (2007) *Taking Action of Adolescent*
- *Literacy an Implementation Guide for School Leaders.* International Reading
- Association. 51

3 Shifts	6 Shifts
1. Building knowledge through content-rich literary nonfiction and informational texts.	**PK-5, Balance of informational and literary text**
	6-12, Building knowledge in the disciplines
2. Reading and writing grounded in evidence from text.	Text-based answers
	Writing to/from sources
3. Regular practice with complex text and its academic vocabulary.	Staircase of complexity
	Academic vocabulary

CCSS Reading Informational (Grade 5)	CCSS Reading Standards for Literacy in Science & Technical Subjects (Grades 6-8)
7. Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. **5RI7**	7. Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). **6-8RS/TS7**
8. Explain how an author uses reasons and evidence to support particular points in a text, identifying which reasons and evidence support which point(s). **5RI8**	8. Distinguish among facts, reasoned judgment based on research findings, and speculation in a text. **6-8RS/TS8**
9. Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. **5RI9**	9. Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. **6-8RS/TS9**
10. By the end of the year, read and comprehend informational texts, including history/social studies, science, and technical texts, at the high end of the grades 4-5 text complexity band independently and proficiently. **5RI10**	10. By the end of grade 8, read and comprehend science/technical texts in the grades 6-8 text complexity band independently and proficiently. **6-8RS/TS10**

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Math & Literacy
Mixing it Up!

The goal is to give students literacy tasks and instruction that *best supports math* **not** distract from it.

- *Taking Action of Adolescent Literacy, 54*

Mathematical Literacy – More than just vocabulary

The National Council of Teachers of Mathematics (NCTM), the New York State Standards, and the Partnership for 21st Century Skills present

communication

-the ability to use language to express mathematical ideas precisely-

as a vital skill for all students in mathematics.

"Effective vocabulary instruction does not rely on definitions, students must represent their knowledge of words in linguistic and nonlinguistic ways…"

Students gradually gain word meaning through:

- Multiple exposures
- Discussion of terms they are learning

Marzano, 2004; Marzano & Pickering, 2005

Simplifying the language is not always better…

Read these numbers…

1/3

2.07

Implement these ideas, right away! HOW? …Encourage students to:

- ✓ Use math words vs. “nonmath” words
- ✓ Answer in complete sentences
- ✓ Verbally explain their answers/processes
- ✓ Keep a personal math word wall
- ✓ Become the expert of a mathematical word (describe, visually represent, act out, categorize, and share)

Disciplinary Reading

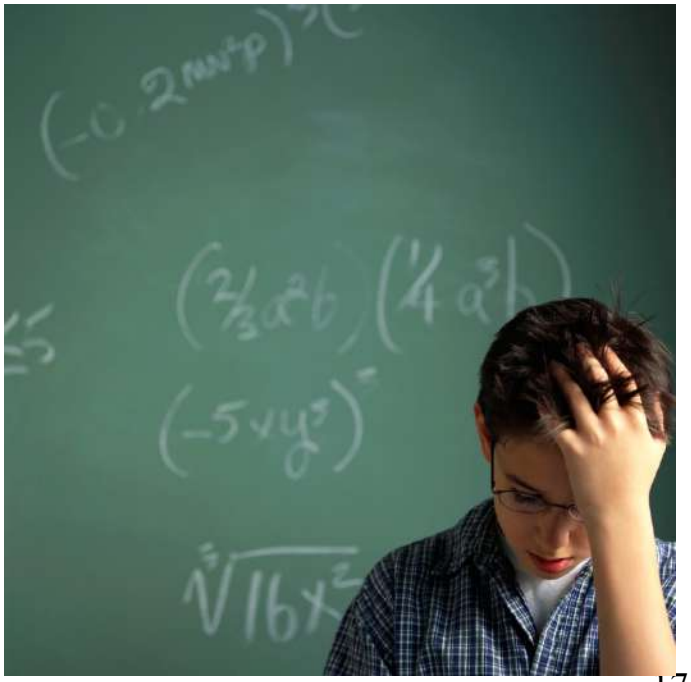
- Specialized skills and activities
- Idea is to consider the learning demands of subject matter
- Example: text is essential
  - Pictures differ in their role
  - Technical drawings
  - Information may be descriptive, sequential, relational, hierarchical, causal

According to Langer (2011), “subject-area teachers, who are disciplinary experts, need to guide, model, and provide opportunities for students to try out and step into the ways of thinking that are appropriate to that discipline”

As teachers invite students to become learners in academic disciplines, they need to provide discipline-specific strategy instruction, increased opportunities to read, differentiated reading materials, and literacy assessment.

Reading Like a Mathematician

- As a mathematician, what strategies do you use to access and read math problems and texts?



Sample literacy tasks for mathematics students:

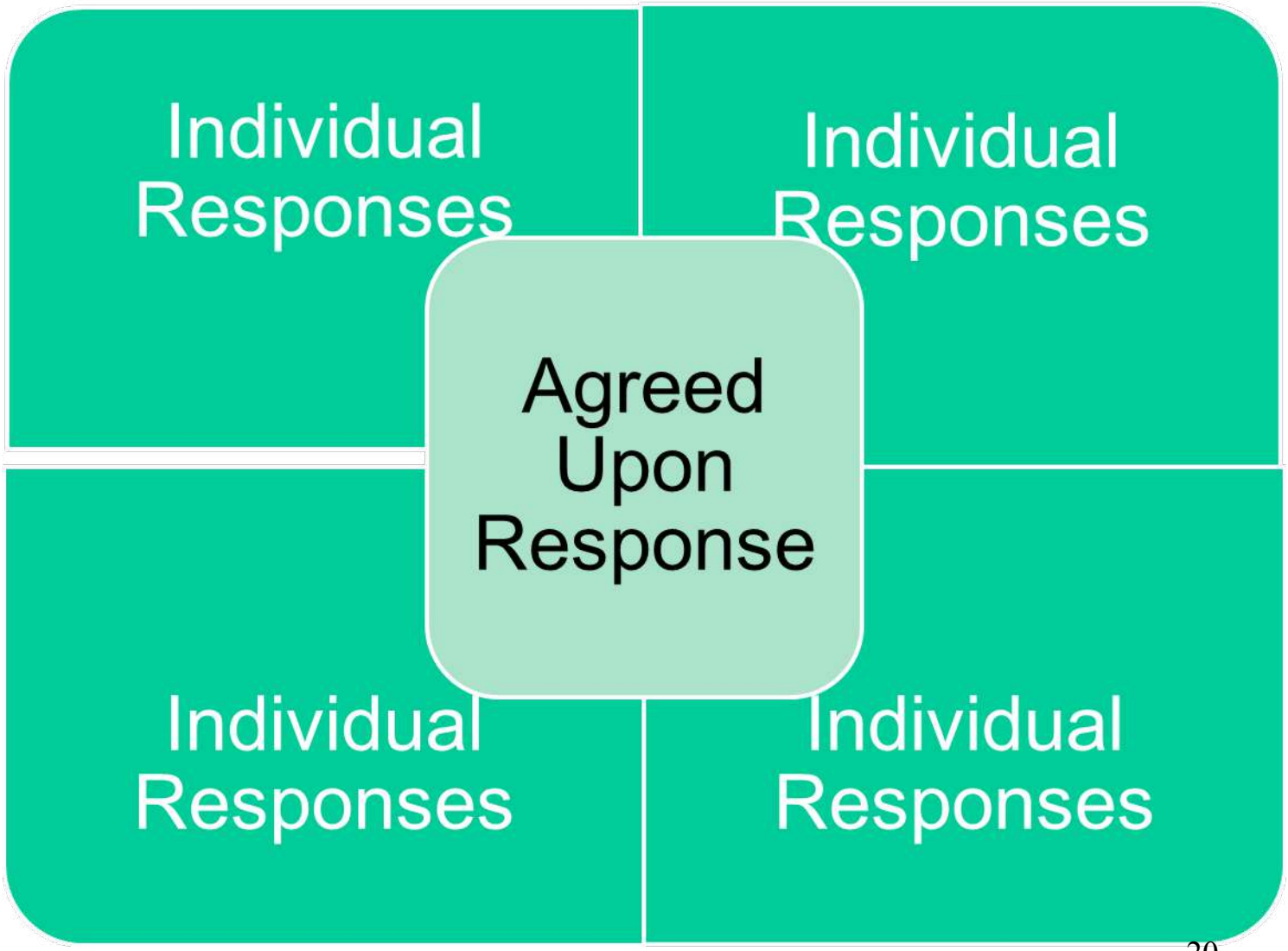
- Understand processes
- Grasp abstract concepts and translate them into symbols
- Distinguish patterns
- Decode words and numeric and nonnumeric symbols
- Translate words into problems and problems into words
- Use journals to write about and examine ideas and reflect on solutions
- Write paragraphs to compare key concepts, such as a line and a plane

Placemat Activity

On the chart paper…

- Individually list ideas and strategies you use to help students read text in your mathematics classroom.
- With your table group decide which strategies you find to be most successful in a mathematics classroom.

Place Mat Activity : Math Strategies



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of the equation. Here we are using either the addition or the subtraction property of equality.

$$\begin{aligned} 2x + 3 &= 15 \\ 2x + 3 + (-3) &= 15 + (-3) \\ 2x &= 12 \end{aligned} \qquad \text{or} \qquad \begin{array}{r} 2x + 3 = 15 \\ -3 \quad\; -3 \\ \hline 2x = 12 \end{array}$$

Now we have a simpler equation that has the same solution set as the original and includes only multiplication by 2. To solve this simpler equation, we multiply both sides of the equation by $\frac{1}{2}$, the reciprocal of 2, or divide both sides of the equation by 2. Here we can use either the multiplication or the division property of equality.

$$\begin{aligned} 2x &= 12 \\ \tfrac{1}{2}(2x) &= \tfrac{1}{2}(12) \\ x &= 6 \end{aligned} \qquad \text{or} \qquad \begin{aligned} 2x &= 12 \\ \tfrac{2x}{2} &= \tfrac{12}{2} \\ x &= 6 \end{aligned}$$

After an equation has been solved, we **check** the equation, that is, we verify that the solution does in fact make the given equation true by replacing the variable with the solution and performing any computations.

$$\begin{aligned} \textit{Check:}\quad 2x + 3 &= 15 \\ 2(6) + 3 &= 15 \\ 12 + 3 &= 15 \\ 15 &= 15 \checkmark \end{aligned}$$

To find the solution of the equation $2x + 3 = 15$, we used several properties of the four basic operations and of equality. The solution below shows the mathematical principle that we used in each step.

$2x + 3 = 15$	Given
$(2x + 3) + (-3) = 15 + (-3)$	Addition property of equality
$2x + [3 + (-3)] = 15 + (-3)$	Associative property of addition
$2x + 0 = 12$	Additive inverse property
$2x = 12$	Additive identity property
$\frac{1}{2}(2x) = \frac{1}{2}(12)$	Multiplication property of equality
$[\frac{1}{2}(2)]x = \frac{1}{2}(12)$	Associative property of multiplication
$1x = 6$	Multiplicative inverse property
$x = 6$	Multiplicative identity property

These steps and properties are necessary to justify the solution of an equation

Math Class Needs a Makeover

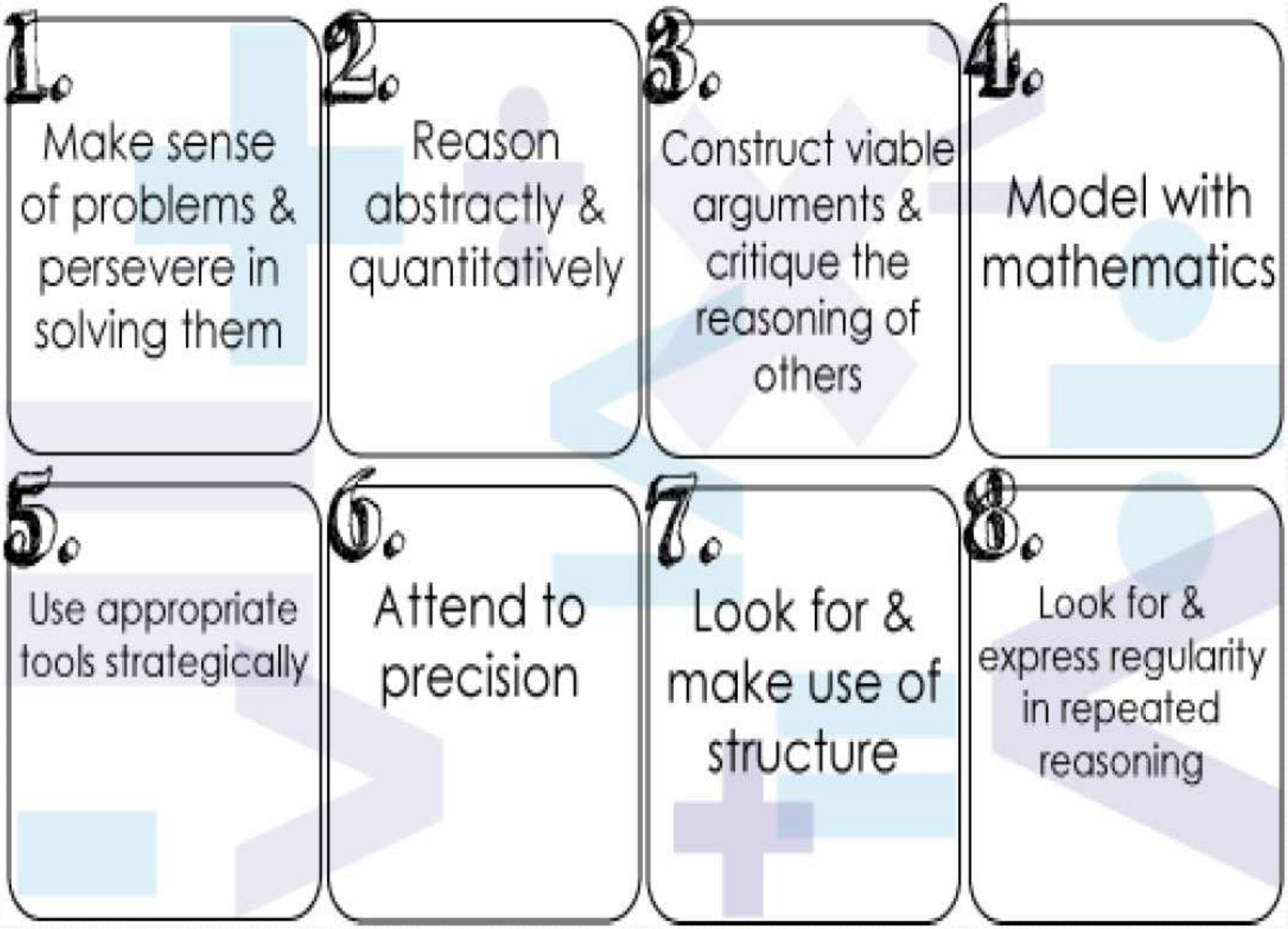
- http://www.ted.com/talks/dan_meyer_math_curriculum_makeover.html

- As you watch this video, please write some “Aha’s” and “Hmmm?s” so share with the group.

Standards for Mathematical Practices

- "Describe varieties of expertise that mathematics educators should seek to develop **in their students**."
- "Rest on important processes and proficiencies in longstanding importance in mathematics education."
- Are not **WHAT** you teach, but rather **HOW** you teach.

The 8 Standards of Mathematical Practice



Grouping the Standards of Mathematical Practice

1. Make sense of problems and persevere in solving them
6. Attend to precision

2. Reason abstractly and quantitatively

3. Construct viable arguments and critique the reasoning of others

Reasoning and explaining

4. Model with mathematics

5. Use appropriate tools strategically

Modeling and using tools

7. Look for and make use of structure.

8. Look for and express regularity in repeated reasoning.

Seeing structure and generalizing

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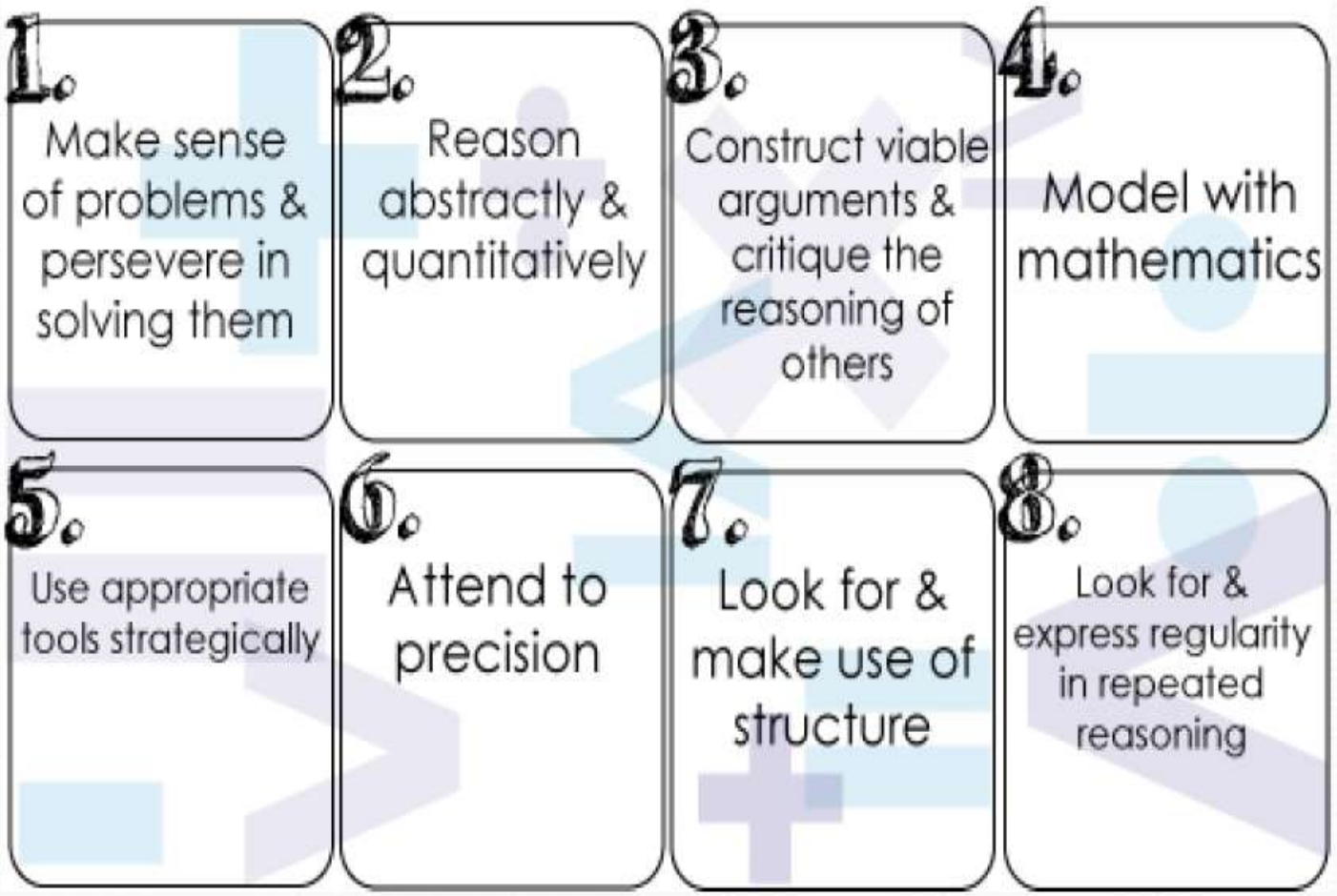
Take a moment…

- To look at the first sentence of each description
- What do you notice?



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They are for… the students!

Diving In…

- Read one Standard of Mathematical Practice.
- Discuss what it means for students and teachers.
- Create a “Looks Like/Sounds Like” t-chart to share.

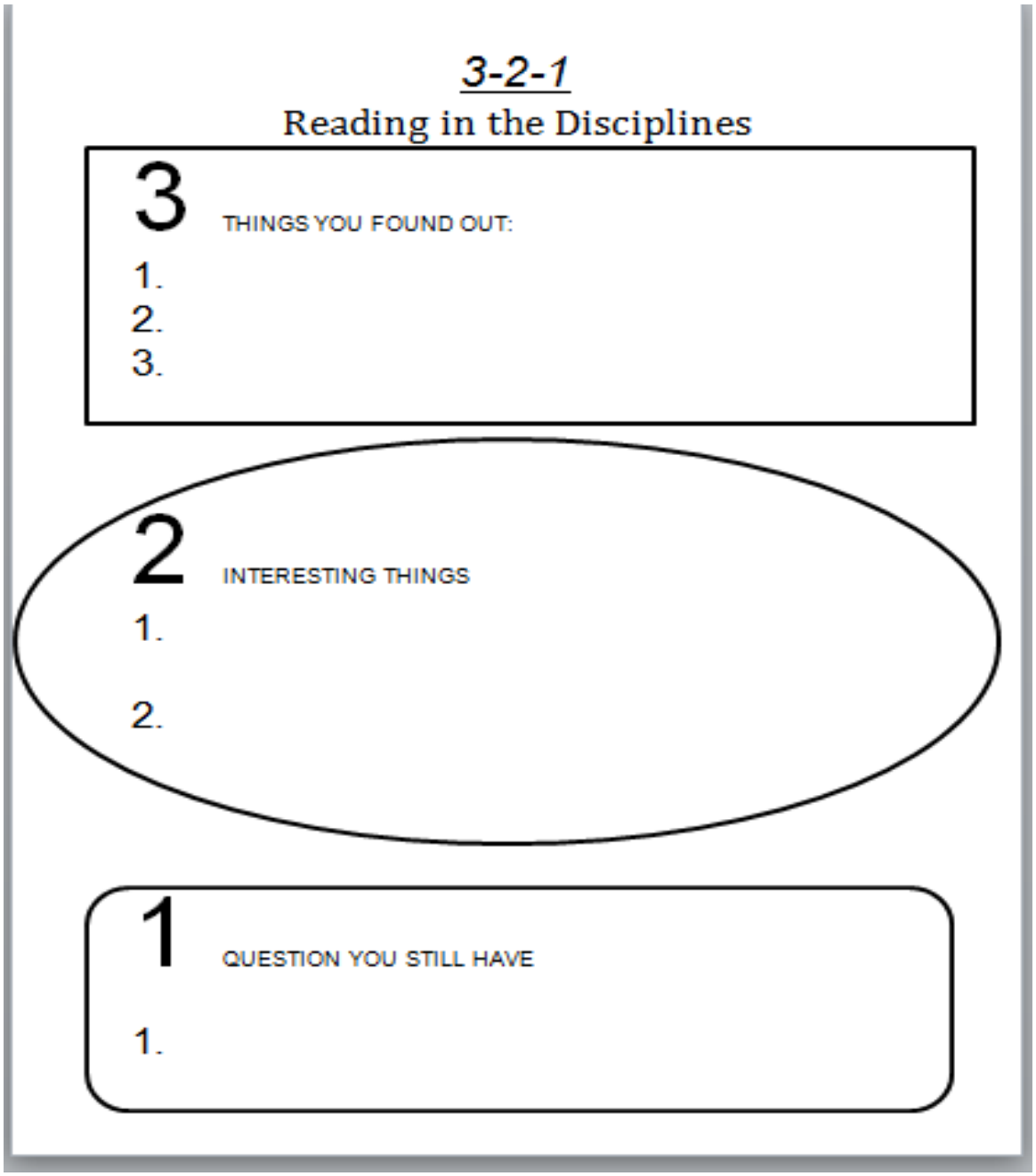
Reading in the Disciplines

The Challenges of Adolescent Literacy

Final Report from Carnegie Corporation of New York's Council on Advancing Adolescent Literacy

Use Paired Reading to read pages 2-4(stop at Reading in Science) and pages 12 (starting with Reading in Mathematics) -15

With your partner, complete 3-2-1.


3-2-1
Reading in the Disciplines
3
THINGS YOU FOUND OUT:
1.
2.
3.
2
INTERESTING THINGS
1.
2.
1
QUESTION YOU STILL HAVE
1.

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The Birthday Paradox:

A professor in a class of 30 random students offers to bet that there are at least two people in the class with the same birthday (month and day, but not necessarily year). Do you accept the bet? What if there were fewer people in the class? Would you bet then?

Assume that the birthdays of n people are uniformly distributed among 365 days of the year (assume no leap years for simplicity). We prove that the probability that at least two of them have the same birthday (month and day) is equal to:

$$1 - \left(\frac{365 \times 364 \times 363 \times \ldots \times (365 - n + 1)}{365^n}\right)$$

What is the chance that among 30 random people in a room, there are at least two or more with the same birthday? For $n = 30$, the probability of at least one matching birthday is about 71%. This means that with 30 people in your class, the professor should win the bet 71 times out of 100 in the long run. It turns out that with 23 people, she should win about 50% of the time.

Here is the proof: Let $P(n)$ be the probability in question. Let $Q(n) = 1 - P(n)$ be the probability that no two people have a common birthday. Now calculate Q(n) by calculating the number of n birthdays without any duplicates and divide by the total number of n possible birthdays. Then solve for P(n).
The total number of n birthdays without duplicates is:

$$365 \times 364 \times 363 \times \ldots \times (365 - n + 1).$$

This is because there are 365 choices for the first birthday, 364 for the next and so on for n birthdays. The total number of n birthdays without any restriction is just 365^n because there are 365 choices for each of n birthdays. Therefore, $Q(n)$ equals

$$\frac{365 \times 364 \times 363 \times \ldots \times (365 - n + 1)}{}.$$

The Birthday Paradox

- With your table group role play the math conversation surrounding *The Birthday Paradox* math problem.

- With your table group discuss how this type of conversations relate to your current or upcoming math units.

Teaching Channel

- https://www.teachingchannel.org/videos/high-school-algebra-lesson

- How is discipline specific literacy integrated with math instruction?
- How and what can students learn from each other as they work through each rotation?
- What 21st Century Skills are evident in this lesson?

Discipline Specific Literacy Strategies for Math

- http://www.uwlax.edu/faculty/kosiak/projects/talks/wsraslides.pdf

- great examples of math graphic organizers

Performance Tasks: Implications on Instruction

- Examine a Smarter Balanced or CTE Performance Task by looking for the following:
  - Which shifts are evident?
  - What are the literacy demands of this task?
  - What types of “text” are being used?

Smarter Balanced Grade 11 Mathematics Performance Task

Thermometer Crickets

- Classroom Activity
- Student Task

Resources

- DOE CCSS Website
  - Literacy Concept Organizers for Social Studies and Science
  - Literacy Standards by Content Areas
  - Literacy Design Collaborative
  - The Teaching Channel
  - AchievetheCore.org
  - Guide to the Shifts
  - HQPD Moduleshttp://www.nysut.org/educatorsvoice_14846.htm

Module Extensions

- Ways to identify literacy demands of the content area
- Evidence of the Shifts in Practice
- List of discipline-specific genres (what do scientists read…)
- List of anchor texts (examples of the above)
- Examples of reading like, “a historian”, “scientist”, “mathematician”, etc.
- Using discipline-specific text as models for writing
- Research that supports literacy in this discipline
- Examples of some of the literacy standards

Ticket Out the Door

- How will you use the information from this presentation include literacy specific instruction in your classroom?