# DEVELOPING REASONING AND PROBLEM SOLVING SKILLS THROUGH CHILDREN'S LITERATURE

Cindy Cliche
Twitter: @cindycliche1
cindy.cliche@cityschools.net

Jeremy Winters
jwiinters@mtsu.edu

# OBJECTIVES FOR TODAY'S SESSION

- Focus on literature-based high level tasks and strategies to promote reasoning and problem solving.

- Be able to evaluate tasks with the Task Analysis Guide presented in Principles to Actions.

- Participants will leave with ideas and resources for integrating literacy into math lessons.

Read 4-6 books each day!

Build conceptual understanding

# WHAT NCTM SAYS

Indicates the importance of the “collaboration of reading and mathematics and asserted that reading children’s literature involving mathematics needs more emphasis in the K-4 curriculum.

# WAYS STUDENT BENEFITS FROM READING AND WRITING MATHEMATICALLY

- Focus on and work through problems.
- Communicate ideas coherently and clearly.
- Organize ideas and structure arguments.
- Extend their thinking and knowledge to encompass other perspective and experiences.
- Understand their own problem solving and thinking processes as well as those of others.
- Develop flexibility in representing and interpreting ideas.

# WAYS TO INTEGRATE CHILDREN'S LITERATURE

- **Providing a context for problems.**
  - Introducing manipulatives
  - Model a creative experience
- **Pose an interesting problem**
  - Prepare for a concept or skill
  - Develop a concept or skill

# DEVELOPING TASKS FROM CHILDREN'S LITERATURE

Three Important Resources

# PRINCIPLES TO ACTION

| Mathematics Teaching Practices |
| --- |
| **Establish mathematics goals to focus learning.** Effective teaching of mathematics establishes clear goals for the mathematics that students are learning, situates goals within learning progressions, and uses the goals to guide instructional decisions. |
| **Implement tasks that promote reasoning and problem solving.** Effective teaching of mathematics engages students in solving and discussing tasks that promote mathematical reasoning and problem solving and allow multiple entry points and varied solution strategies. |
| **Use and connect mathematical representations.** Effective teaching of mathematics engages students in making connections among mathematical representations to deepen understanding of mathematics concepts and procedures and as tools for problem solving. |
| **Facilitate meaningful mathematical discourse.** Effective teaching of mathematics facilitates discourse among students to build shared understanding of mathematical ideas by analyzing and comparing student approaches and arguments. |
| **Pose purposeful questions.** Effective teaching of mathematics uses purposeful questions to assess and advance students' reasoning and sense making about important mathematical ideas and relationships. |
| **Build procedural fluency from conceptual understanding.** Effective teaching of mathematics builds fluency with procedures on a foundation of conceptual understanding so that students, over time, become skillful in using procedures flexibly as they solve contextual and mathematical problems. |
| **Support productive struggle in learning mathematics.** Effective teaching of mathematics consistently provides students, individually and collectively, with opportunities and supports to engage in productive struggle as they grapple with mathematical ideas and relationships. |
| **Elicit and use evidence of student thinking.** Effective teaching of mathematics uses evidence of student thinking to assess progress toward mathematical understanding and to adjust instruction continually in ways that support and extend learning. |

# THE MATHEMATICAL TASK ANALYSIS GUIDE

## Lower-Level Demands

### Memorization Tasks

- Involve either producing previously learned facts, rules, formulae, or definitions OR committing facts, rules, formulae, or definitions to memory.
- Cannot be solved using procedures because a procedure does not exist or because the time frame in which the task is being completed is too short to use a procedure.
- Are not ambiguous – such tasks involve exact reproduction of previously seen material and what is to be reproduced is clearly and directly stated.
- Have no connection to the concepts or meaning that underlie the facts, rules, formulae, or definitions being learned or reproduced.

### Procedures Without Connections Tasks

- Are algorithmic. Use of the procedure is either specifically called for or its use is evident based on prior instruction, experience, or placement of the task.
- Require limited cognitive demand for successful completion. There is little ambiguity about what needs to be done and how to do it.
- Have no connection to the concepts or meaning that underlie the procedure being used.
- Are focused on producing correct answers rather than developing mathematical understanding.
- Require no explanations, or explanations that focus solely on describing the procedure that was used.

## Higher-Level Demands

### Procedures With Connections Tasks

- Focus students' attention on the use of procedures for the purpose of developing deeper levels of understanding of mathematical concepts and ideas.
- Suggest pathways to follow (explicitly or implicitly) that are broad general procedures that have close connections to underlying conceptual ideas as opposed to narrow algorithms that are opaque with respect to underlying concepts.
- Usually are represented in multiple ways (e.g., visual diagrams, manipulatives, symbols, problem situations). Making connections among multiple representations helps to develop meaning.
- Require some degree of cognitive effort. Although general procedures may be followed, they cannot be followed mindlessly. Students need to engage with the conceptual ideas that underlie the procedures in order to successfully complete the task and develop understanding.

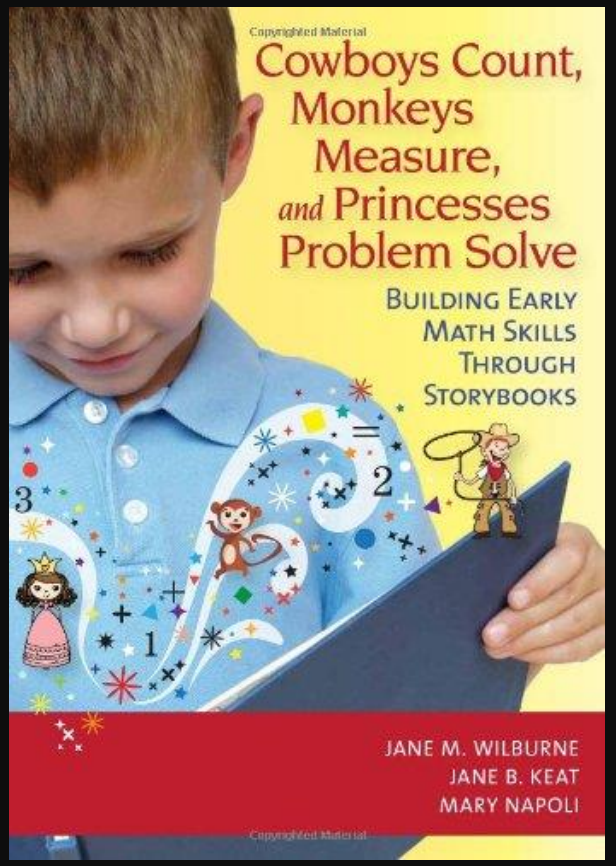
### Doing Mathematics Tasks

- Requires complex and non-algorithmic thinking (i.e., there is not a predictable, well-rehearsed approach or pathway explicitly suggested by the task, task instructions, or a worked-out example).
- Requires students to explore and to understand the nature of mathematical concepts, processes, or relationships.
- Demands self-monitoring or self-regulation of one's own cognitive processes.
- Requires students to access relevant knowledge and experiences and make appropriate use of them in working through the task.
- Requires students to analyze the task and actively examine task constraints that may limit possible solution strategies and solutions.
- Requires considerable cognitive effort and may involve some level of anxiety for the student due to the unpredictable nature of the solution process required.

Stein, M. K., Smith, M. S., Henningsen, M. A., & Silver, E. A. (2000) Implementing standards-based mathematics instruction: A casebook for professional development, p. 16. New York: Teachers College Press.

# A HELPFUL GUIDE

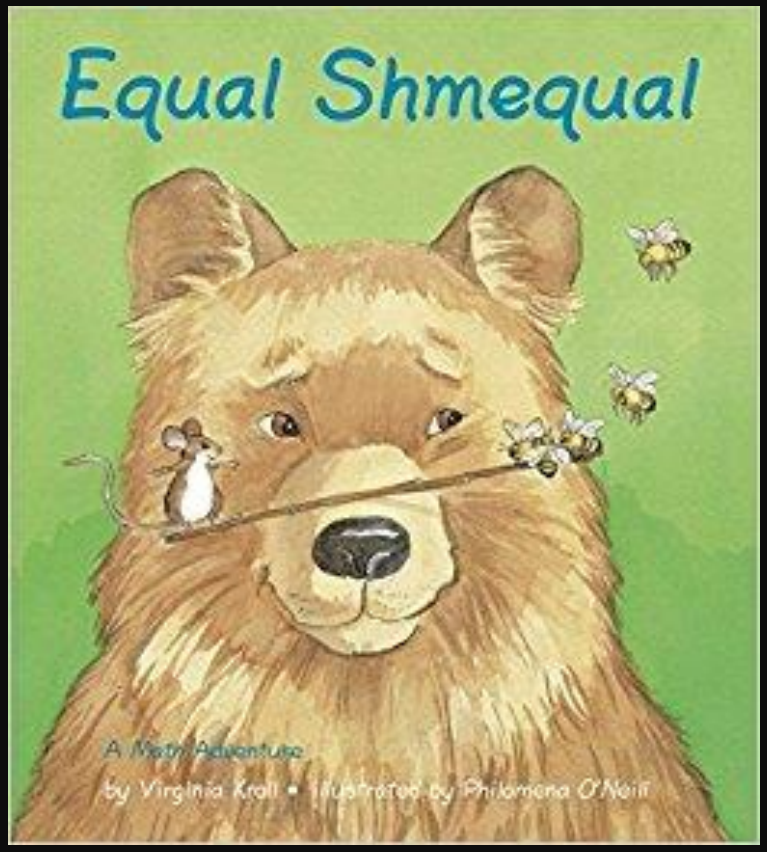
Cowboys Count, Monkeys Measure, and Princesses Problem Solve: Building Early Math Skills Through Storybooks by Jane M. Wilburne, Jane B. Keat and Mary Napoli



# 3 SAMPLES

- Equal Shmequal (1st grade)
- My Little Sister Ate One Hare (Kindergarten)
- Six Dinner Sid (2nd Grade)

# EQUAL SHMEQUAL



# EQUAL SHMEQUAL

**Task A**

**There were some animals on one side of the seesaw. There were four animals on the other side. There are 11 animals on the seesaw. How many animals were on the seesaw?**

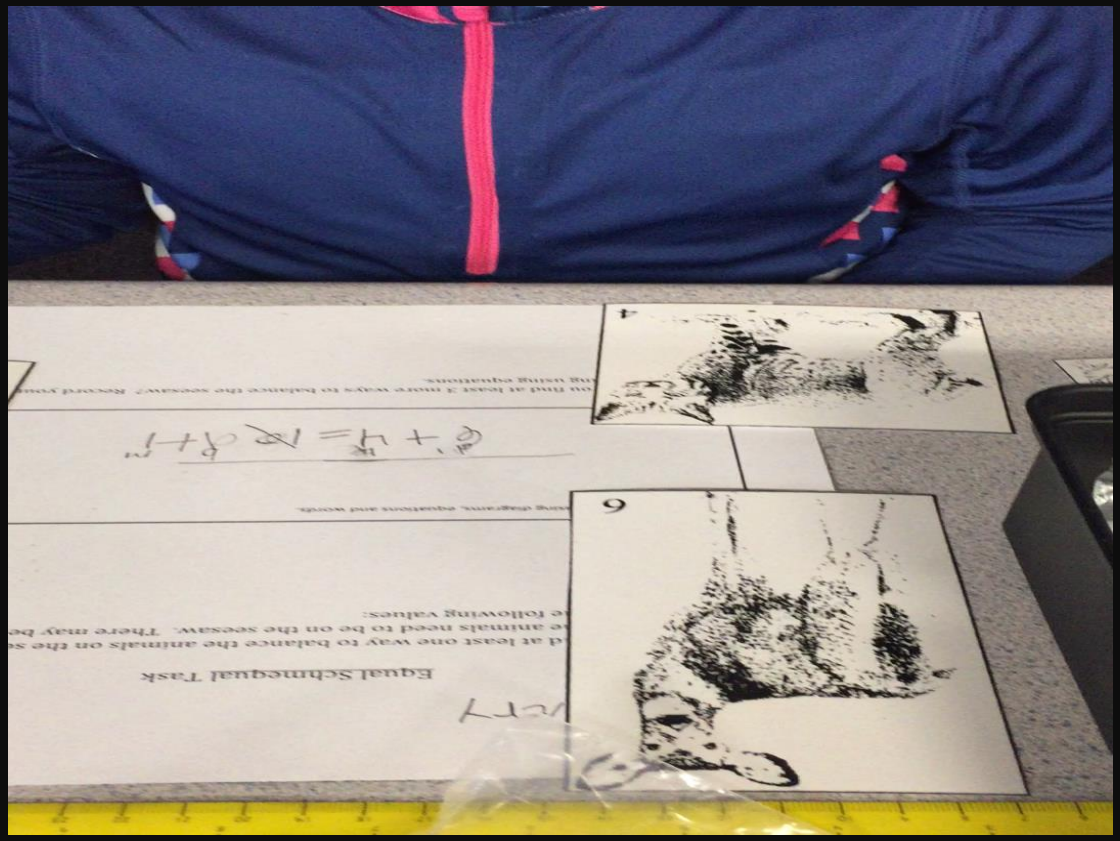
Use diagrams, numbers, and words to explain your thinking

Task B

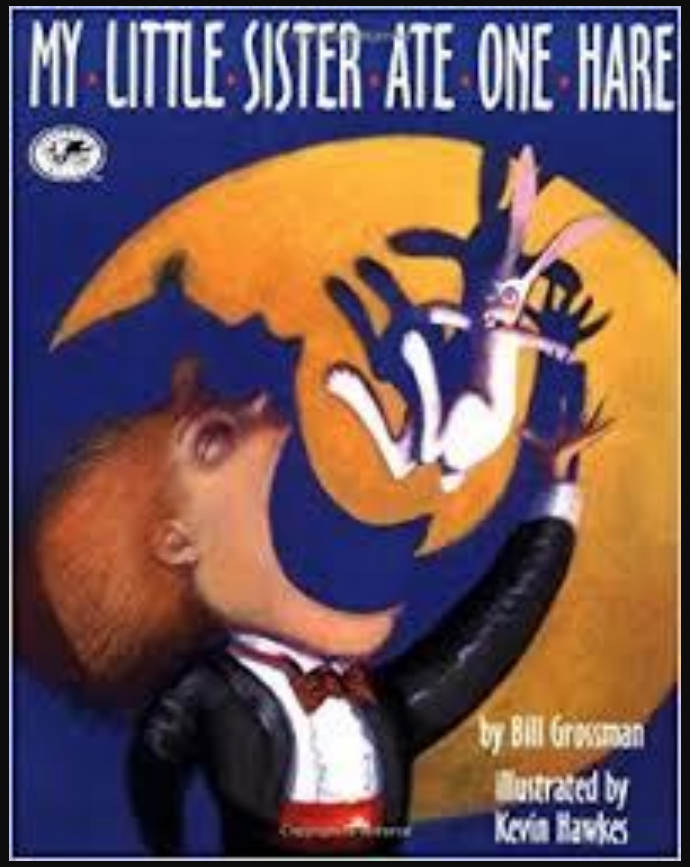
Can you find at least one way to balance the animals on the seesaw? Not all of the animals need to be on the seesaw. There may be just a few. Use the following values:

Bear = 9
Deer =6
Wolf = 5
Bobcat = 4
Rabbit = 3
Turtle = 2
Mouse = 1

# EQUAL SHMEQUAL



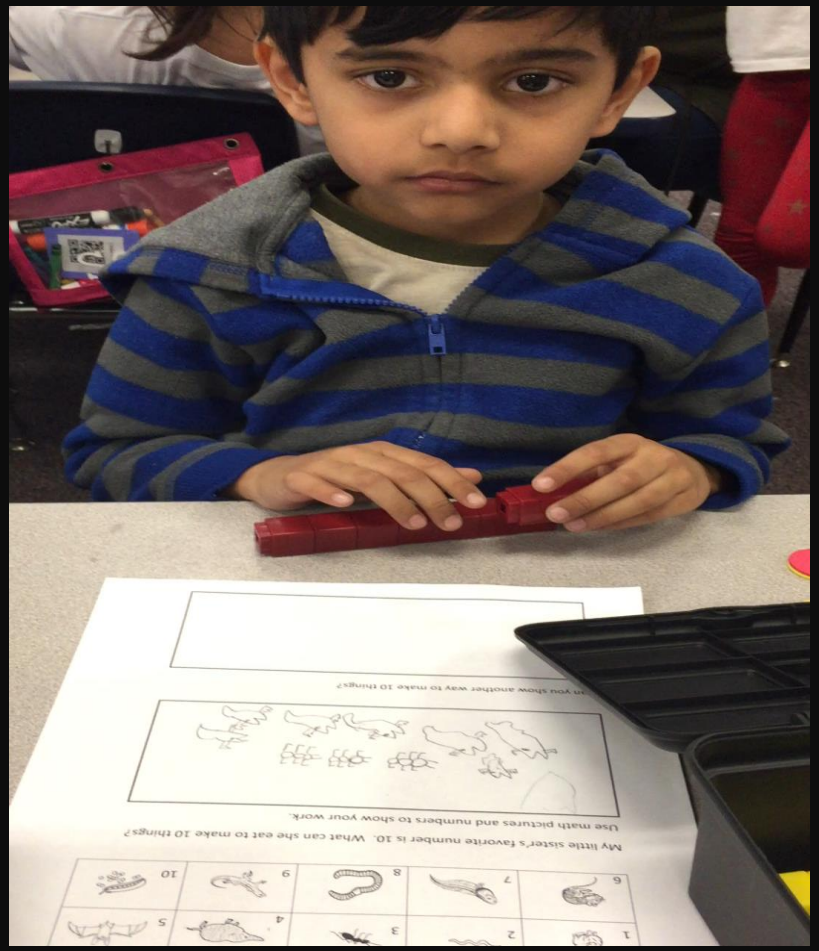
# MY LITTLE SISTER ATE ONE HARE



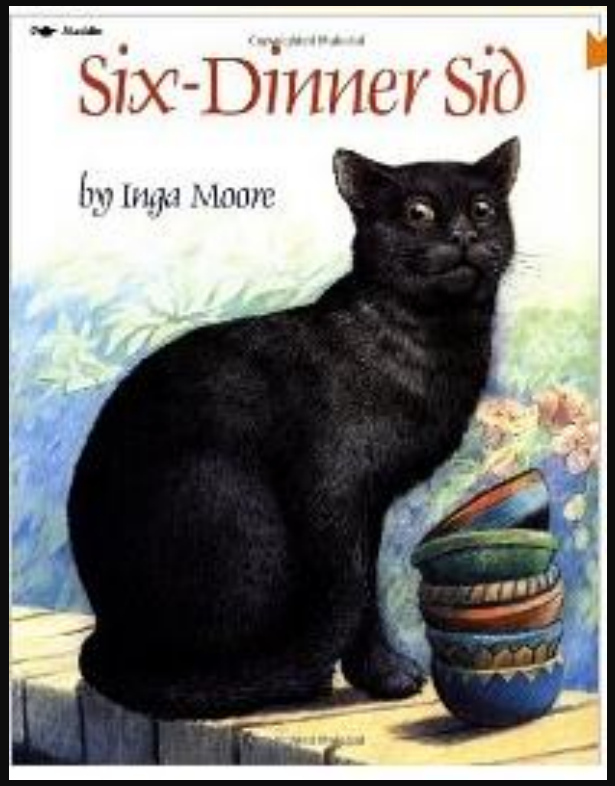
# MY LITTLE SISTER ATE ONE HARE

| | |
|---|---|
| **Task A**<br><br>**My little sister's favorite number is 10.**<br><br>**What can she eat to make 10 things?** | **Task B**<br><br>**Little Sister wants the animals put into the pen so that each column, row, or diagonal she could eat 15 animals. Use the picture cards to show your work.** |
| Task C<br>In the story my sister ate 5 bats and 4 shrews. How many bats and shrews did my sister eat all together? | Task D<br><br>My little sister ate _____<br>number<br>_____.<br>in book |

# MY LITTLE SISTER ATE ONE HARE



# SIX-DINNER SID



# SIX DINNER SID

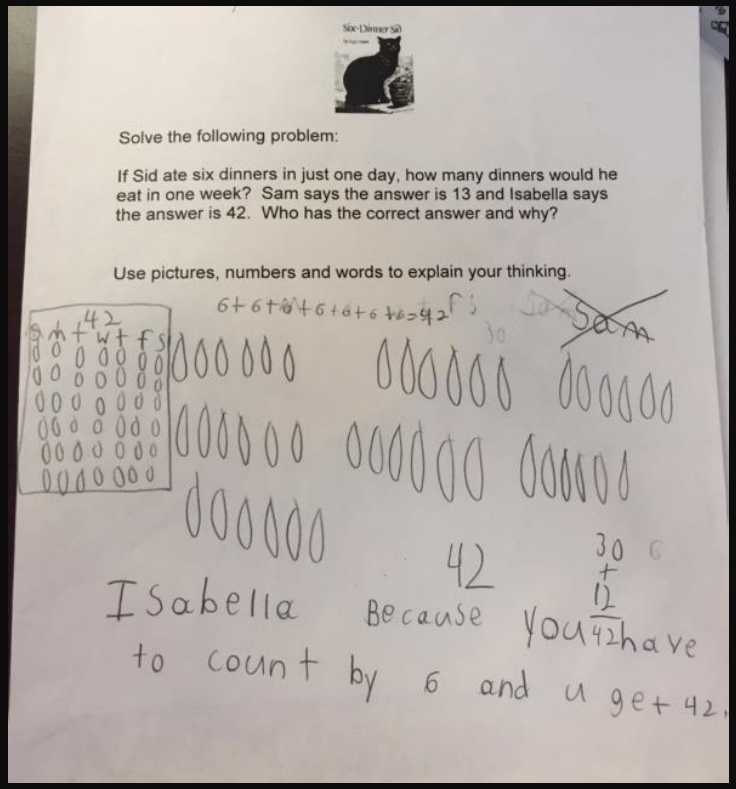
Solve the following problem:

If Sid ate six dinners in just one day, how many dinners would he eat in one week? Sam says the answer is 13 and Isabella says the answer is 42. Who has the correct answer and why?

Use pictures, numbers and words to explain your thinking.

What is the TAG Level? Change the task to make it higher.

# SIX DINNER SID



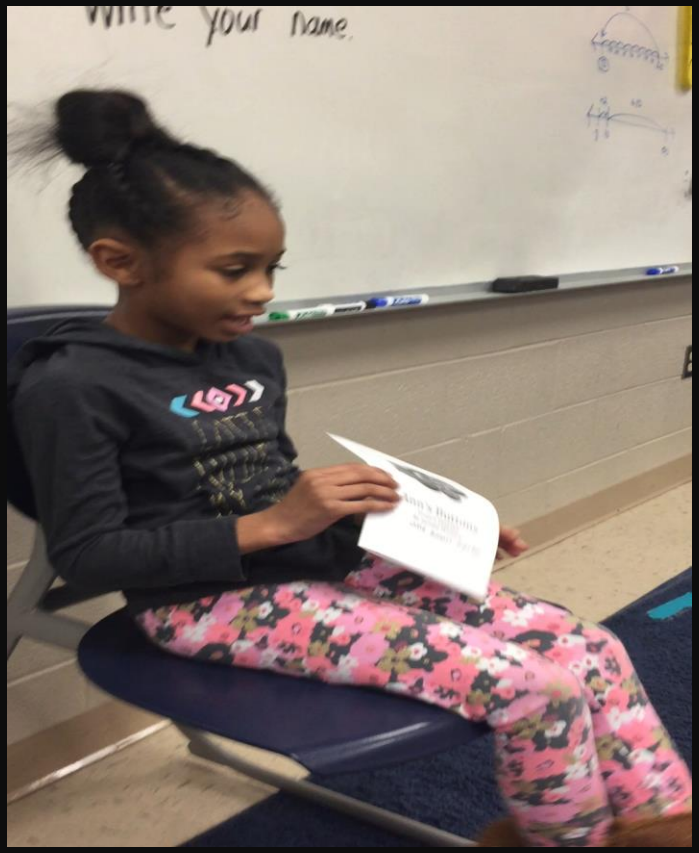
# A TWIST ON BOOKS

Missing Pages

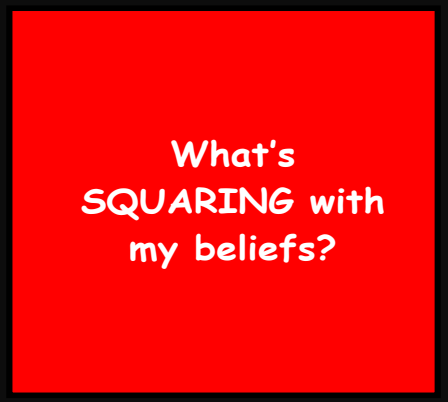
Writing Mathematical Books
for all situations

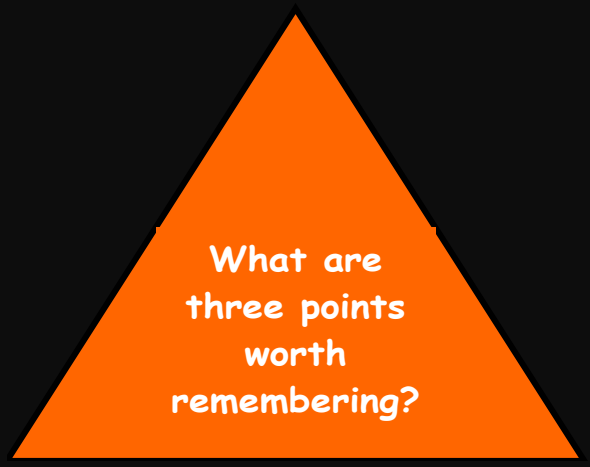
Website:
https://mathmissingpages.wordpress.com/

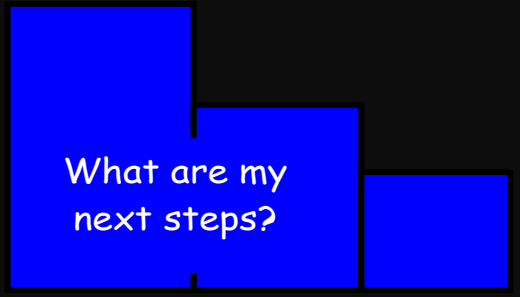
# MISSING PAGES
# SAMPLE WORK



# How are things shaping up?

# RESOURCES

- Math Through Stories