Exploring the 8 Standards of Mathematical Practice

Using the Standards of Mathematical Practice in K-2 Classrooms

Whitney Kibler

SOUTH CAROLINA
STATE DEPARTMENT
OF EDUCATION

Objectives

- What are the 8 Standards of Mathematical Practice?
- How are the 8 Standards of Mathematical Practice included in daily lessons?
- What do the 8 Standards of Mathematical Practice look like in a K-2nd grade classroom?
- How do they integrate with the content standards?

Brainstorm

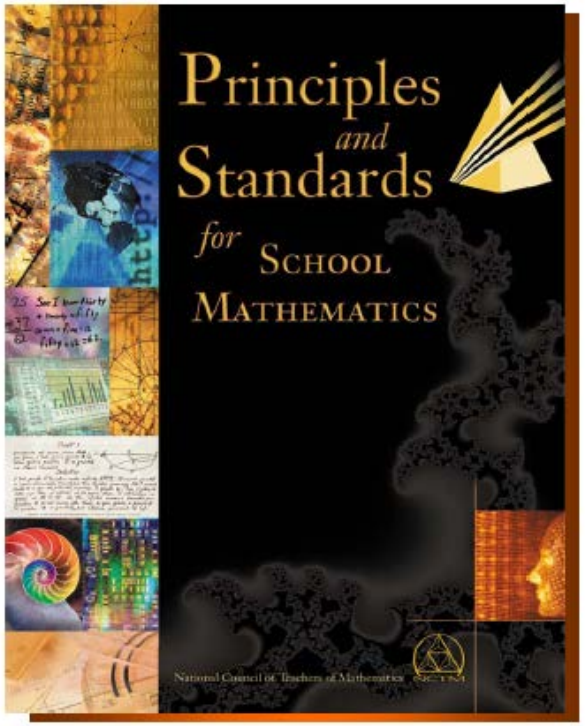
- Discuss the following at your table:
  - What does a classroom look like and sound like when **all** students are engaged in learning mathematics?

Standards of Mathematical Practice

- "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 based on NCTM process standards and strands of mathematical proficiency outlined in the National Research Council's report, *Adding It Up*.
- are not WHAT you teach, but rather HOW you teach.

NCTM Process Standards

- Problem Solving
- Reasoning and Proof
- Connections
- Communication
- Representation

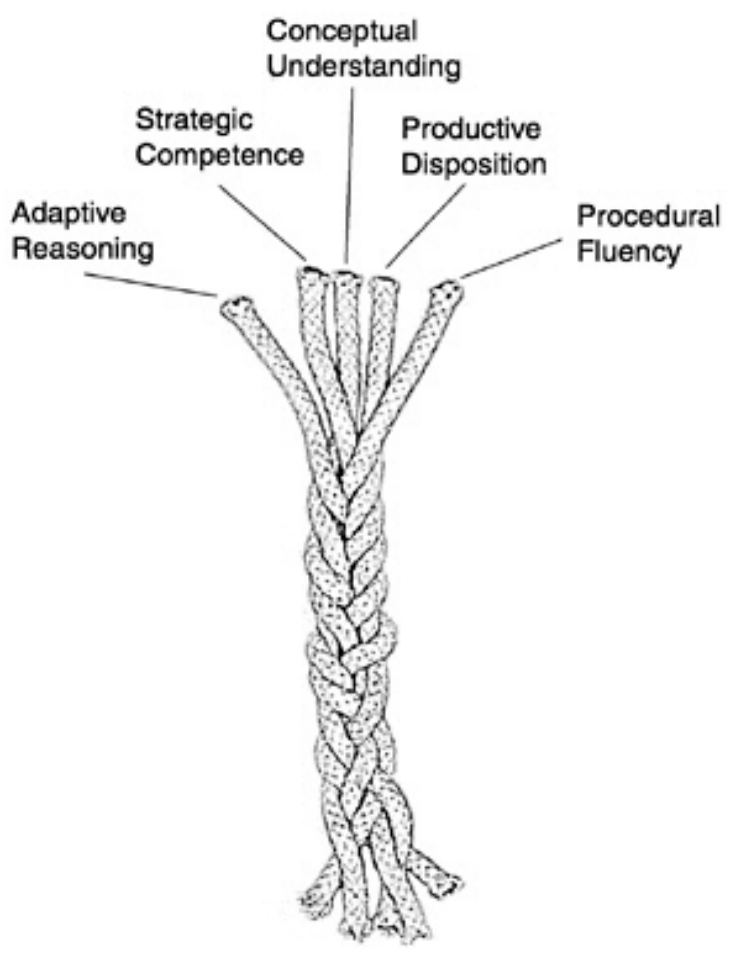


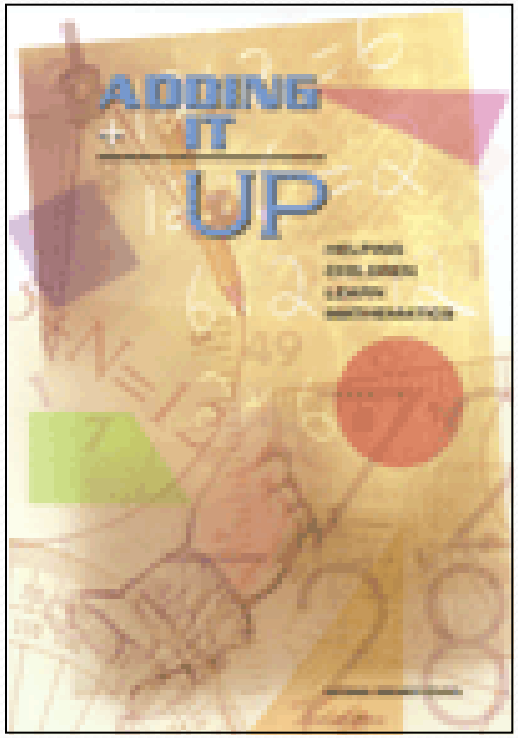
NCTM (2000). *Principles and Standards for School Mathematics*. Reston, VA: Author.

Adding It Up Report (2001)

- Vital that young people understand the mathematics they are learning
- Overriding premise of our work is that throughout the grades PreK-8 all students should learn to think mathematically
- Proficiency is not a one-dimensional trait and cannot be achieved by focusing on one of these strands

Strands of Mathematical Proficiency





Adding It Up: Helping Children Learn Mathematics
By Jeremy Kilpatrick,
Jane Swafford, & Bob Findell (Editors). (2001).
Washington, DC: National Academy Press

The 8 Standards of Mathematical Practice

1. Make sense of problems & persevere in solving them
2. Reason abstractly & quantitatively
3. Construct viable arguments & critique the reasoning of others
4. Model with mathematics
5. Use appropriate tools strategically
6. Attend to precision
7. Look for & make use of structure
8. Look for & express regularity in repeated reasoning

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

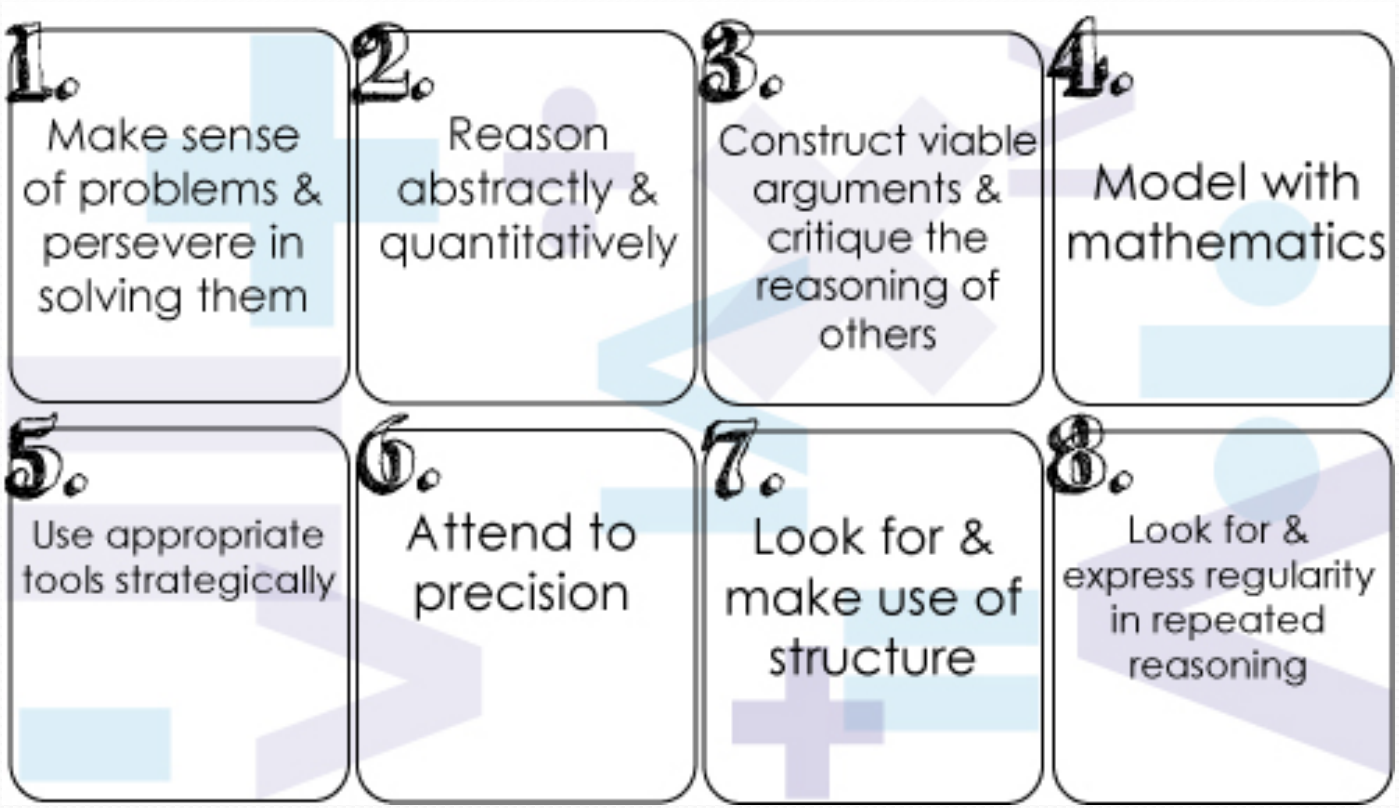
7. Look for and make use of structure.

8. Look for and express regularity in repeated reasoning.

Seeing structure and generalizing

Take a moment…

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



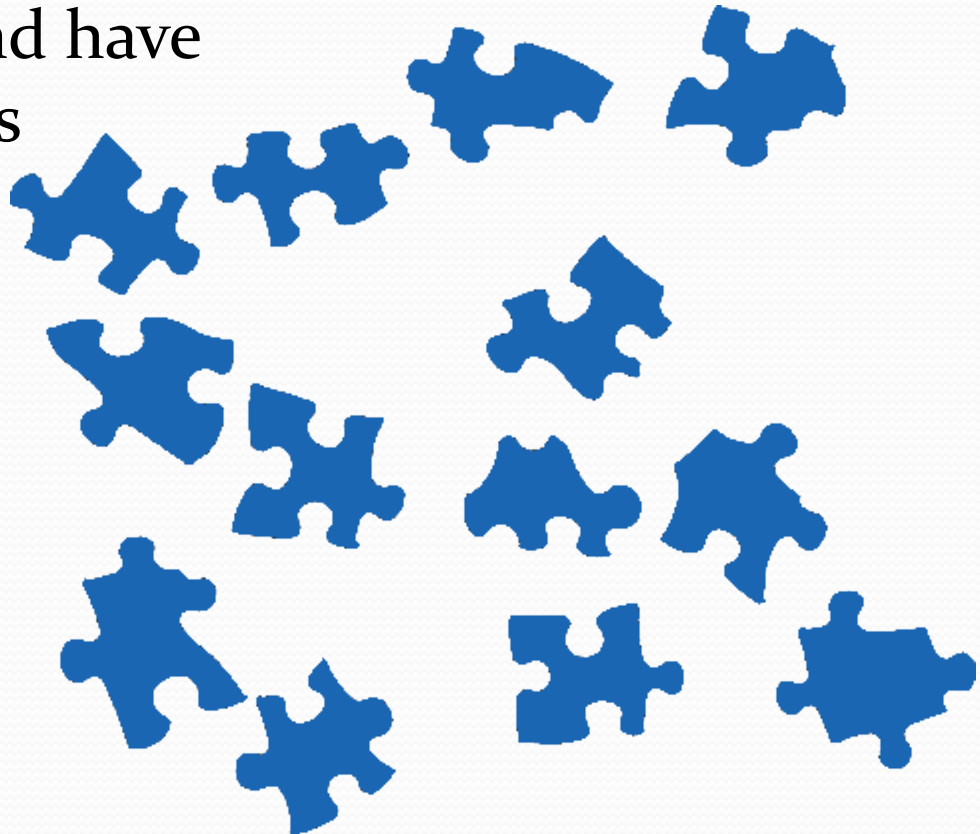
They are for… the students!

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.

Begin at the beginning…

- Suppose you had a 1,000 piece puzzle to do right now.
- You don't have the box and have no idea what the puzzle is supposed to look like.
- What do you do?

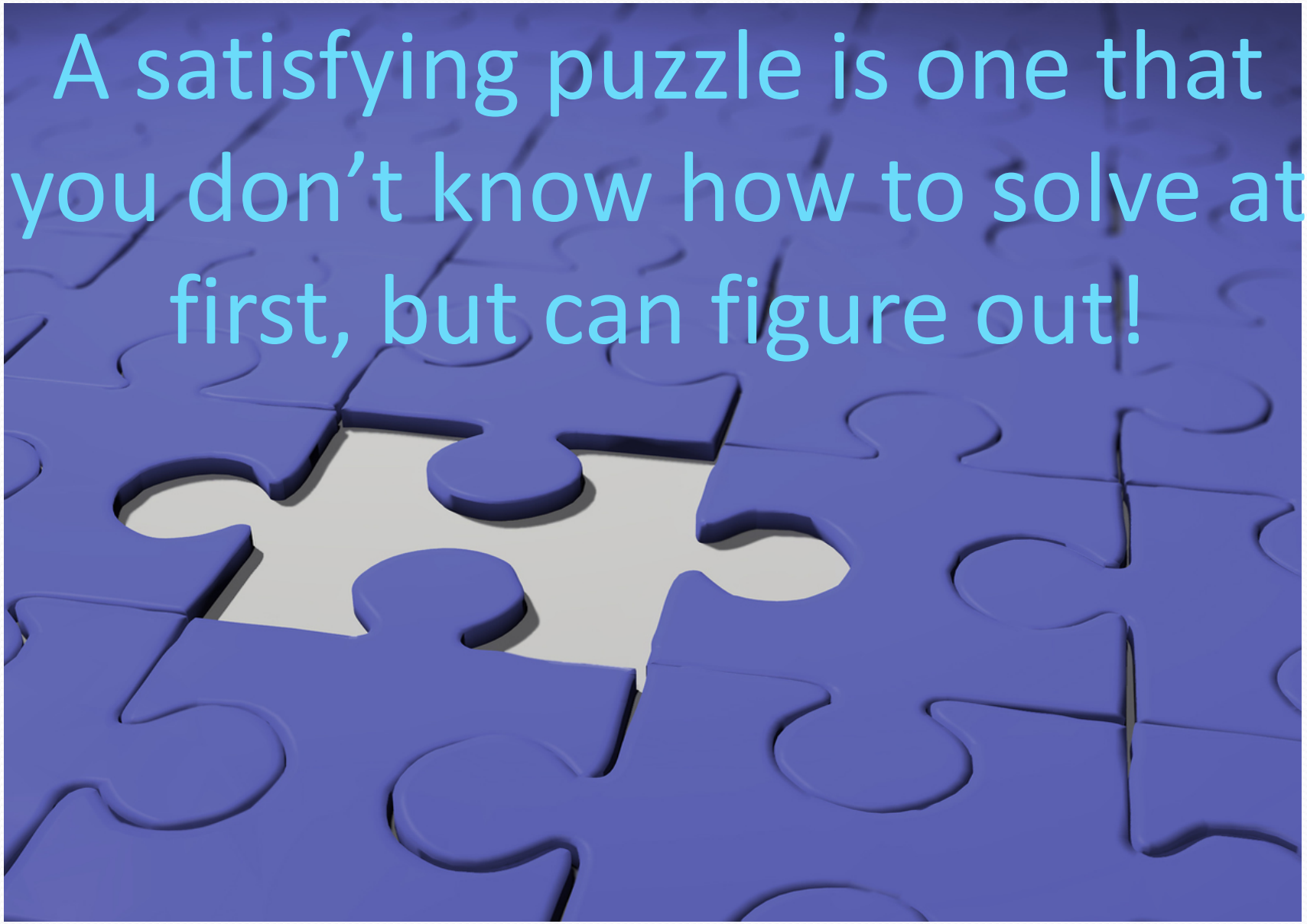


Chances are…

- You have some idea where to start
  - Find the corner pieces
  - Put the edge pieces together
  - Look for matching colors

- And, when you finish
  - You feel successful
  - You have ideas for what to do next time

A satisfying puzzle is one that you don’t know how to solve at first, but can figure out!

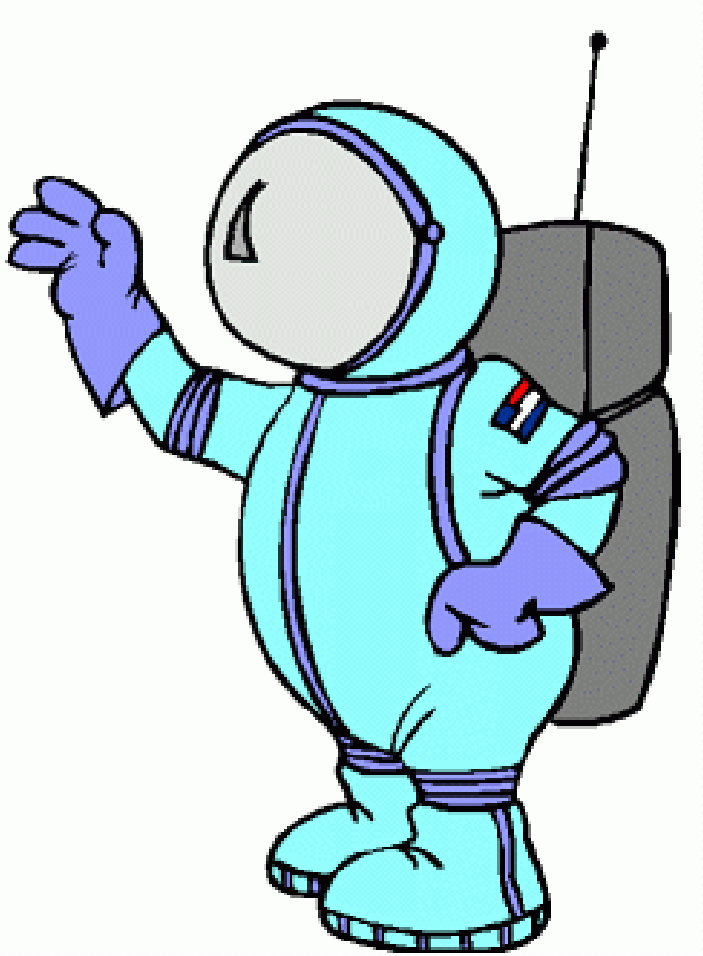


Your First Mission…

- Listen carefully as clues are given.
- Use the color cards in your bag to manipulate the "astronauts" based on the clues.
- A spokesperson from different tables will direct our astronauts to and from the space ship to fit the clues.

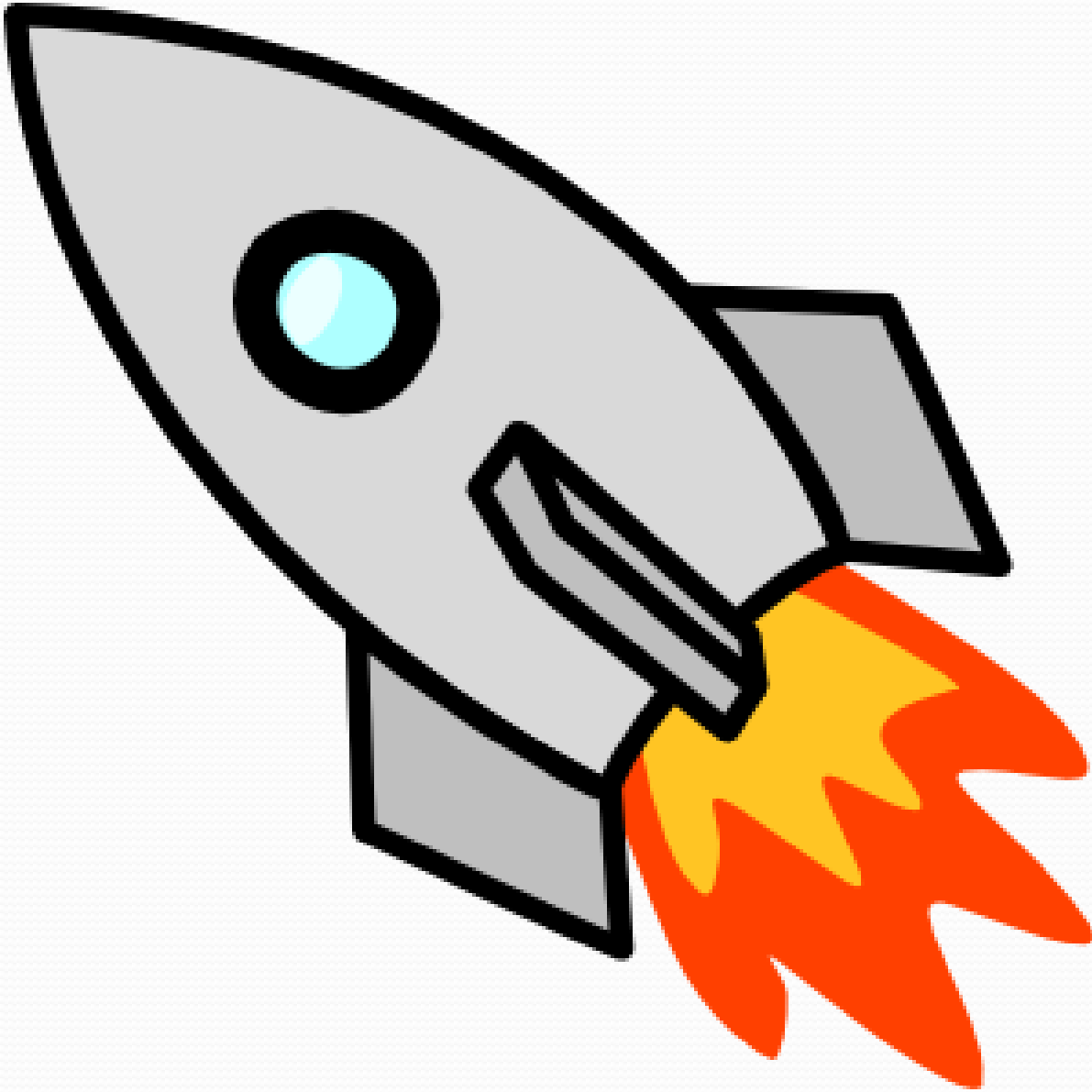
3, 2, 1… BLASTOFF!!!

- Wanted: Twelve volunteers to take a trip into the great unknown! Follow mission control's orders to make sure you don't miss your chance to travel into outer space!



Content Standards:

K.OA.5- Fluently add and subtract within 5.
1.OA.8- Determine the unknown whole number in an addition or subtraction equation relating three whole numbers.
2.OA.2- Fluently add and subtract within 20 using mental strategies.

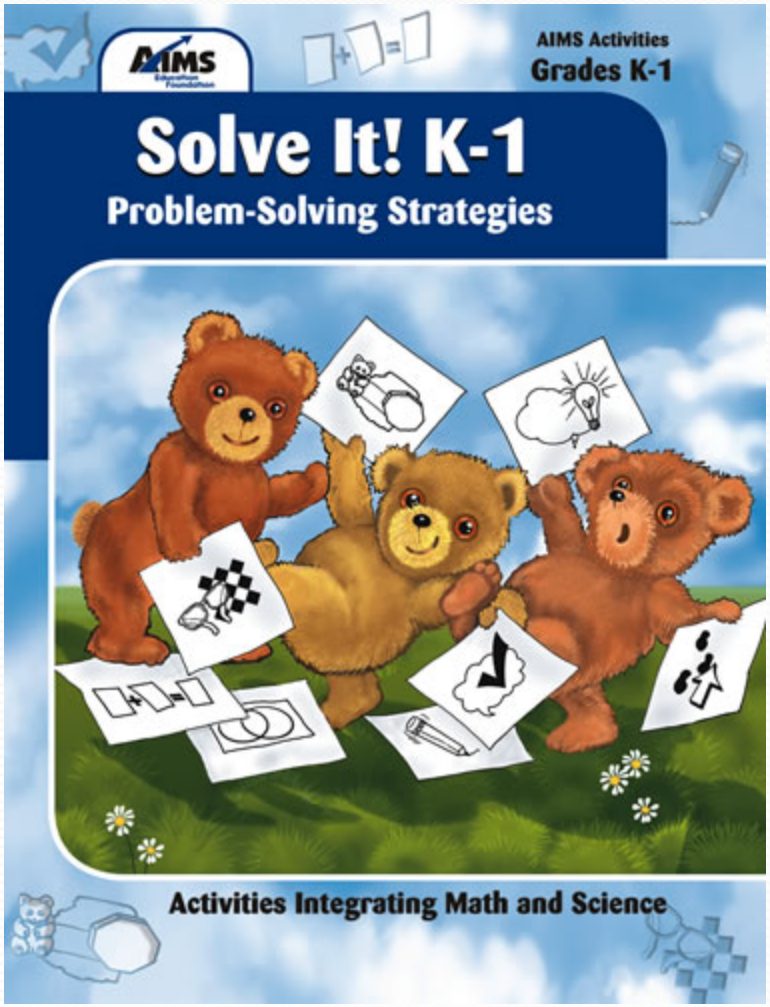


You made it look easy!

How did you know where to begin?

Think about it…

- Think about the 3-2-1, Blastoff! Activity that we just completed.
- The lesson and accompanying activity were taken from an AIMS Problem Solving book, *Solve It! K-1.*



Reflection Time

- Which of the 8 SMPs were addressed in the 3-2-1 Blastoff! Activity?
- How could this activity be modified to address more SMPs?
- How could this activity be modified to address standards at your grade level?

Let’s take a break!

Intro to Math Talks

- Solve:
  - James has 19 more baseball cards in his collection than Michael does. Together, the boys have 57 cards. How many cards does each boy have?

- http://www.mathsolutions.com/videos/Intro_Clip.swf

What is a Math Talk?

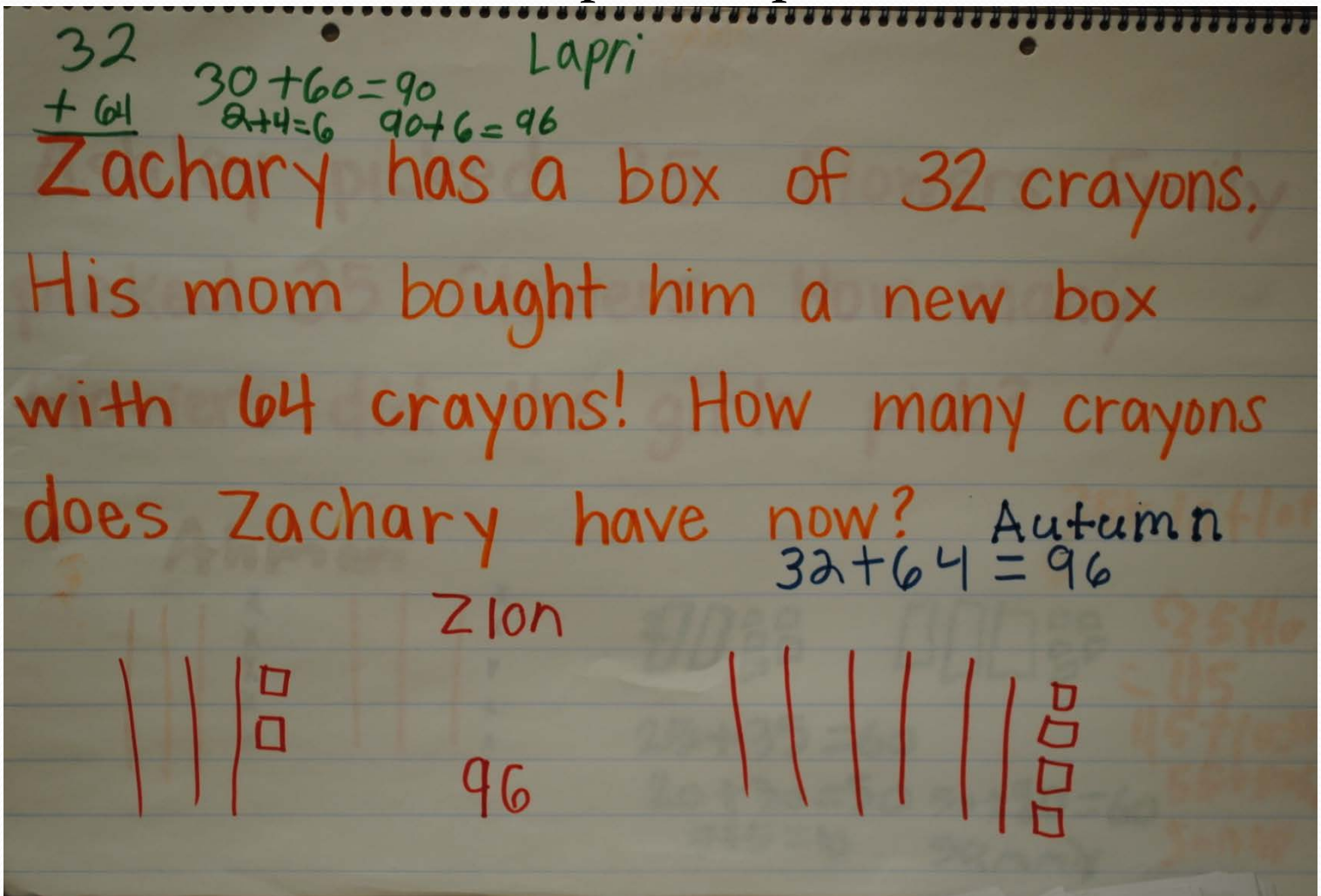
- Sharing
- Discussing
- Reasoning
- Revoicing
- Restating
- Agreeing or Disagreeing
- Evaluating
- Assessing
- Critiquing

Math Talks in Action

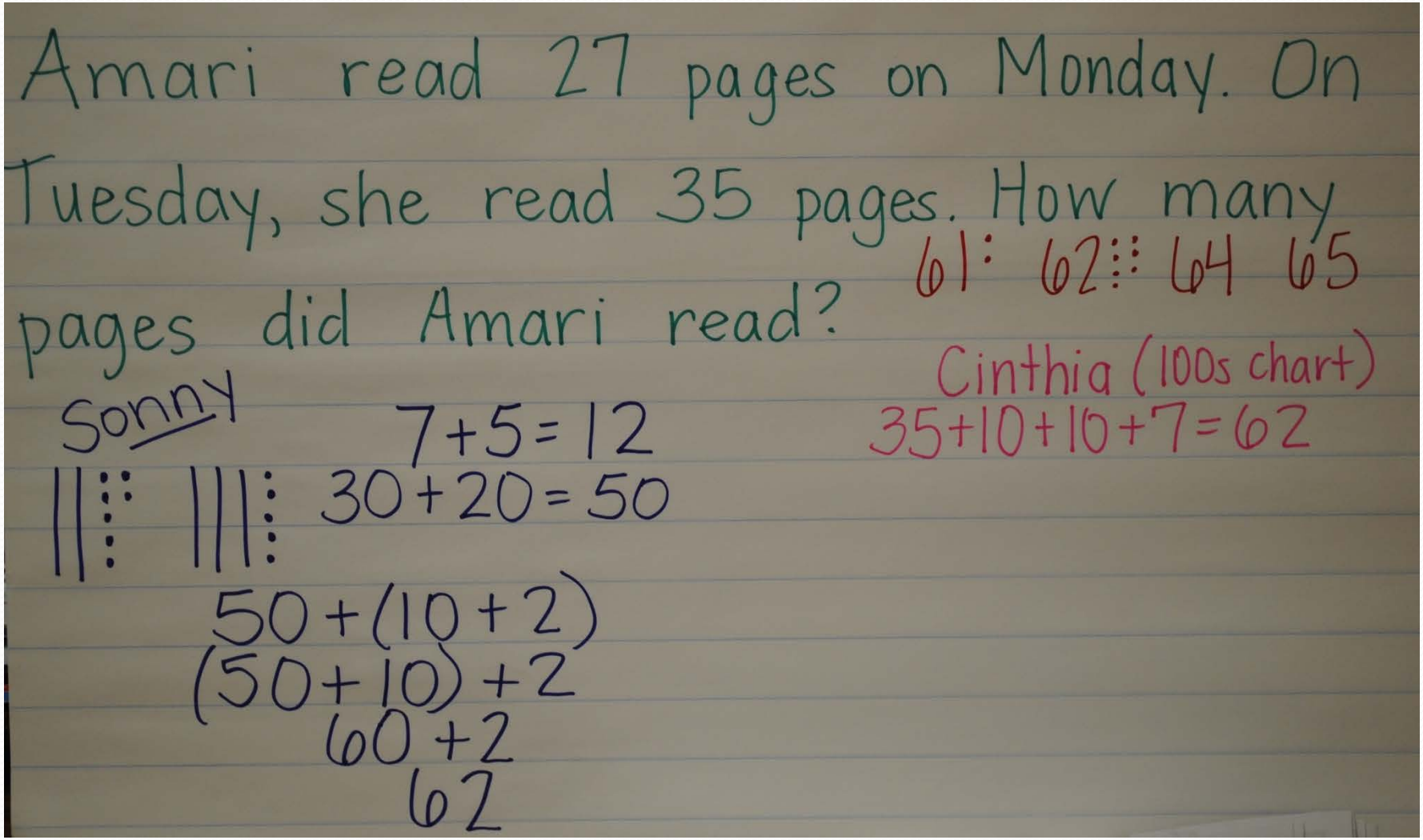
- Kindergarten: http://www.mathsolutions.com/videopage/videos/Final/Guess_My_Number.swf
- 1st Grade: http://www.mathsolutions.com/MathTalk/videos/CRD_Gr1.swf
- 2nd Grade: http://www.mathsolutions.com/videopage/videos/Final/Classroom_NumberTalk_Gr3.swf

Math Talk in my Classroom

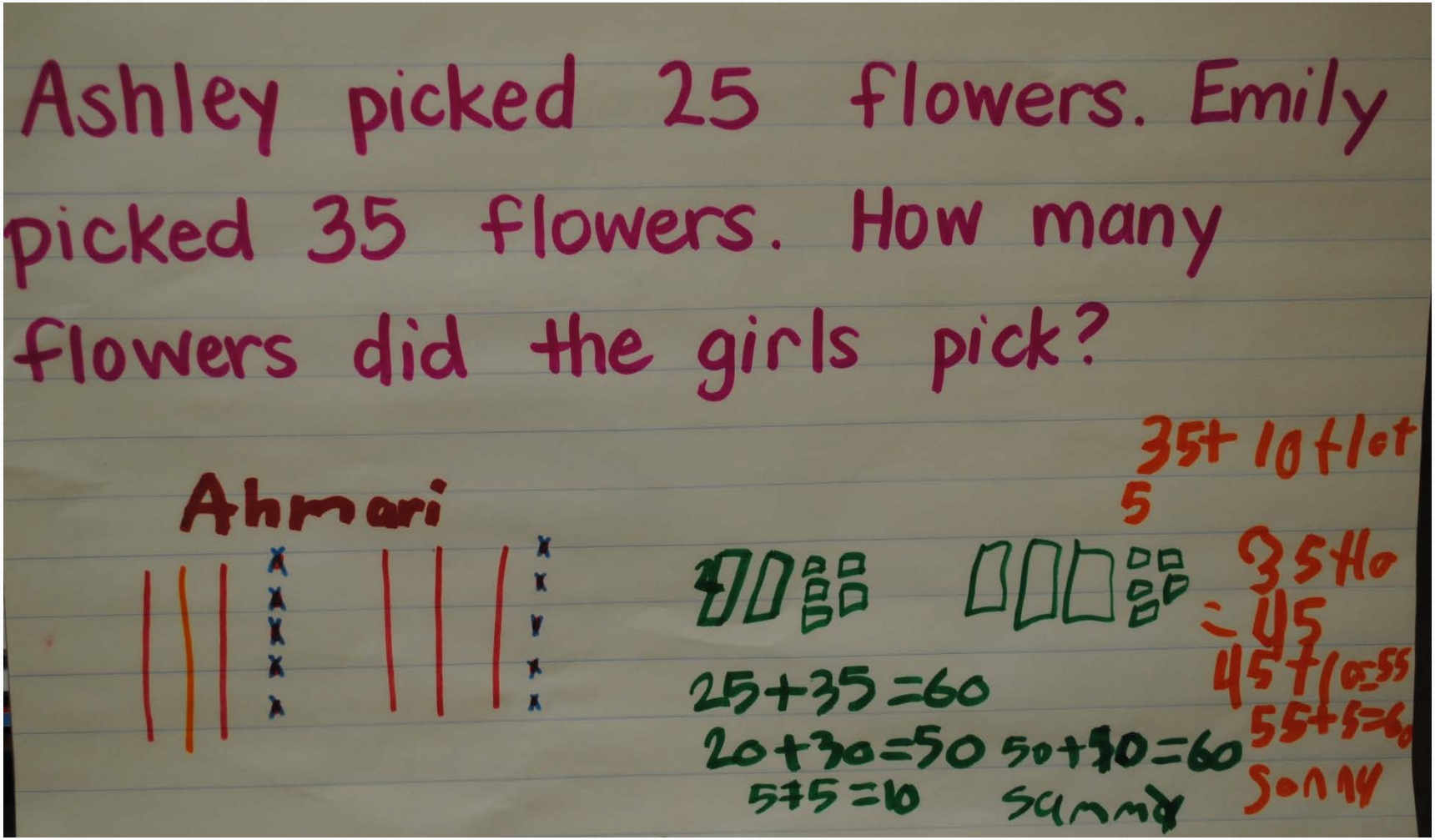
- 2.NBT.1 Use addition and subtraction within 100 to solve one- and two- step word problems.



Math Talk in my Classroom



Math Talk in my Classroom



Turn and Talk

- Which Standards of Mathematical Practice could be addressed with the use of Math Talks?
- How many content standards for your grade level could be addressed with the use of Math Talks?
- As a teacher, what purpose does a Math Talk serve?
- How do students benefit from a classroom that engages in Math Talks?

Longer, Shorter, Same

- K.MD.1 and K.MD.2: Describe measurable attributes of objects. Directly compare two objects with a measurable attribute in common to see which object has “more of”/ “less of” the attribute and describe the difference.
- Sort the 5 objects in your bag
  - Longest to shortest
  - Shortest to longest

We're Going on a Length Hunt

- Take the yarn pieces from your bag.

- Your job is to move around the room and find at least one object that is:
  - Longer than the yarn
  - Shorter than the yarn
  - About the same length as the yarn

More Than One Way

- Choose one object from your bag.
- Measure the object with the ruler.

- Then, measure the same object with the ruler again, but in a different way.

- How many different ways can you use the same ruler to measure one object?

Share Time

- What mathematical concepts did you need in order to do those lessons?
- Which Standards of Mathematical Practice were evident in these lessons?
- How could you incorporate the Standards of Mathematical Practice into your lessons in the Measurement and Data domain?

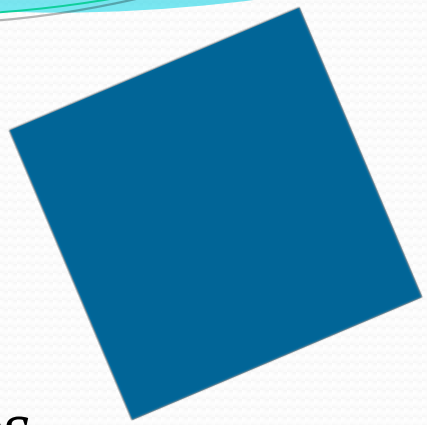
Sort the Words Below into Different Groups

- Apple
- Green
- Purple
- Square
- Banana
- Grapes
- Circle
- Triangle
- Yellow
- Blue

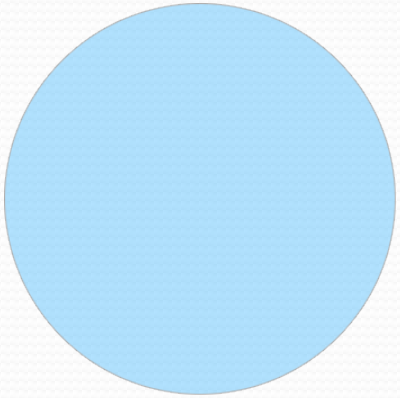
Word Sort

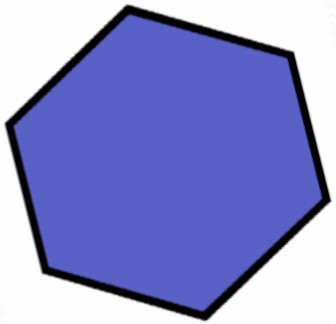
- Colors
  - Green
  - Purple
  - Yellow
  - Blue
- Fruits
  - Apple
  - Banana
  - Grapes
- Shapes
  - Square
  - Circle
  - Triangle

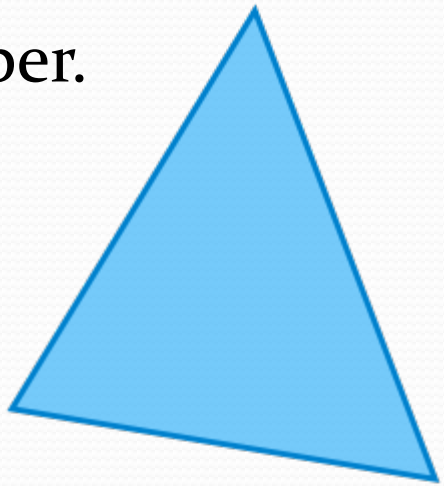
Shape Sort



- Open the envelope in your bag.
- Work with your partner to sort the shapes.
- Determine the number of groups you need to sort the shapes.
- Create a name for each group of shapes .
- Glue the shapes onto the construction paper.







Shape Sort Sharing

- Share at your tables how you and your partner sorted your shapes.
- Did any other partners do the same thing?
- Did other partners sort their shapes differently?

Mystery Definition

- Provide students with examples and non-examples
- Students use these figures to determine qualities
- Students create their own definition (to be followed later with a more detailed definition)

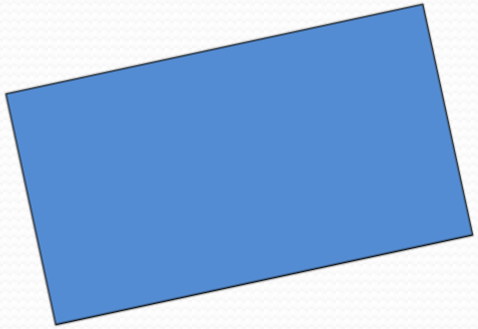
Mystery Definition

YES **NO**

Mystery Definition

YES

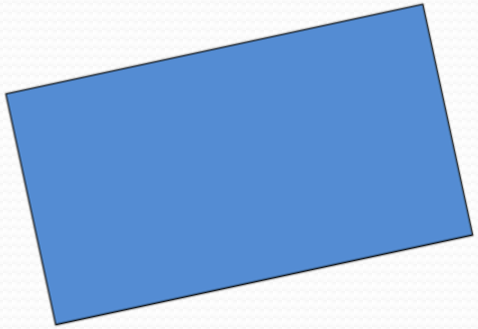
NO

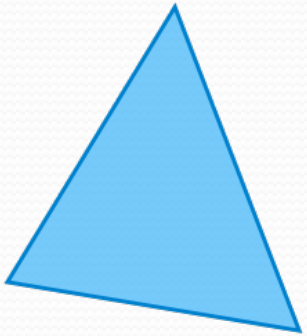


Mystery Definition

YES

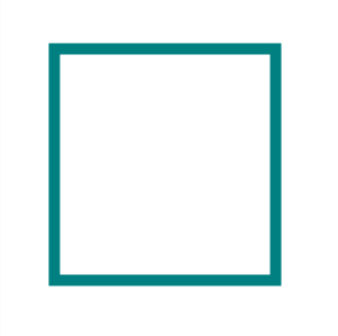
NO



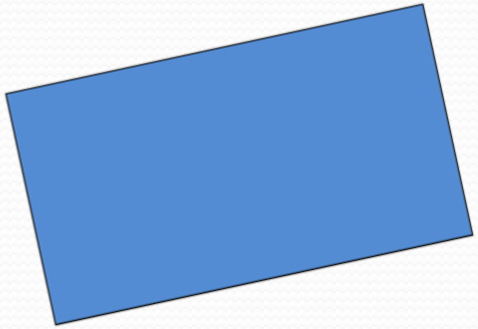


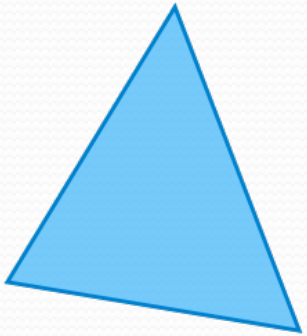
Mystery Definition

YES



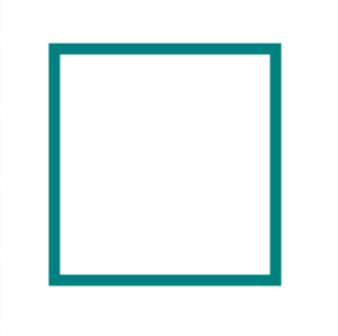
NO

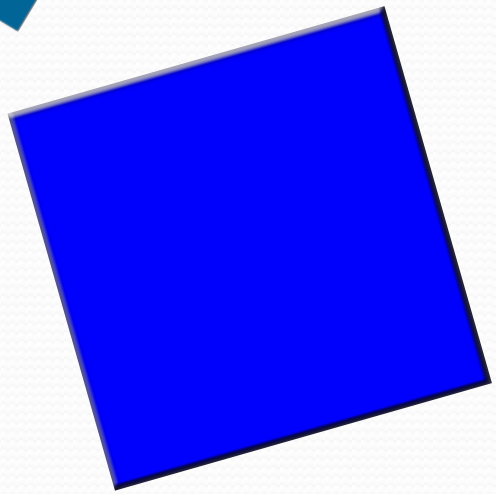




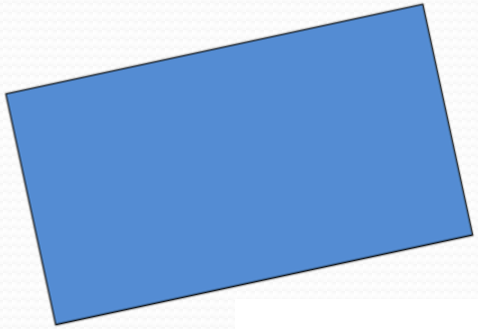
Mystery Definition

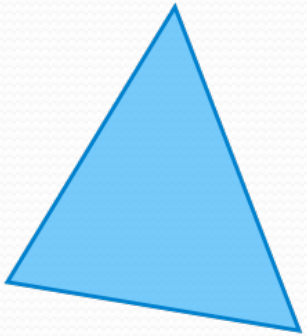
YES

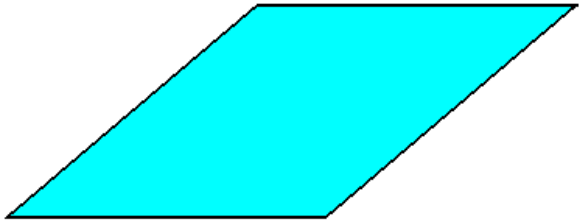




NO







The 8 Standards of Mathematical Practice

1. Make sense of problems & persevere in solving them
2. Reason abstractly & quantitatively
3. Construct viable arguments & critique the reasoning of others
4. Model with mathematics
5. Use appropriate tools strategically
6. Attend to precision
7. Look for & make use of structure
8. Look for & express regularity in repeated reasoning

Teacher Actions/Responsibilities

- Provide time for and facilitate discussion
- Provide time to think and problem solve
- Encourage students to check answers using different methods
- Provide problems that require flexible use of objects and properties of operations
- Encourage and facilitate students in justifying their conclusions, communicating, and responding to others
- Ask questions to clarify and improve students' arguments
- Provide situations that apply to everyday life
- Focus on conceptual understanding
- Expect precision in communication (written and oral)
- Provide a variety of tools and technology
- Provide opportunities to look for patterns

Student Actions/Responsibilities

- Engage in solving problems and thinking is visible
- Discuss with peers, make conjectures, plan, utilize strategies
- Ask “Does it make sense?”
- Use different representations and strategies
- Justify, defend, and communicate conclusions to others
- Recognize and explain flaws in arguments
- Ask questions to improve arguments
- Apply math to everyday life
- Write equations to describe situations
- Use and define mathematical symbols and representations
- Use appropriate tools
- Analyze and use patterns to see relationships and structure in mathematics

Neat Finds and Questions

- Kansas Association for Teachers of Mathematics
  - http://katm.org/wp/common-core/
  - Flipbooks
  - Other lesson and unit ideas for CCSS

- Questions???

One final thought…

- "And once I had a teacher who understood. He brought with him the beauty of mathematics. He made me create it for myself. He gave me nothing, and it was more than any other teacher has ever dared to give me"

  - Cochran (*The Art of the Universe)*

- **What do YOU dare give to your students?**

Contact Information

- Whitney Kibler
  - wkibler@newberry.k12.sc.us

- Mary Ruzga
  - Education Associate for STEM, SCDE
  - mruzga@ed.sc.gov