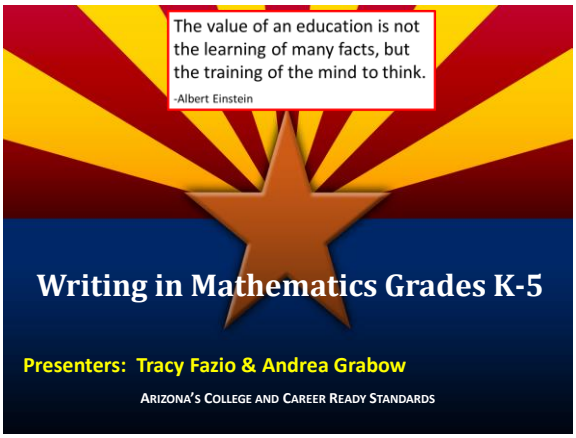


"Students who have opportunities , encouragement, and support for speaking, writing, reading and listening in mathematics classes reap dual benefits: they communicate to learn mathematics, and they learn to communicate mathematically."

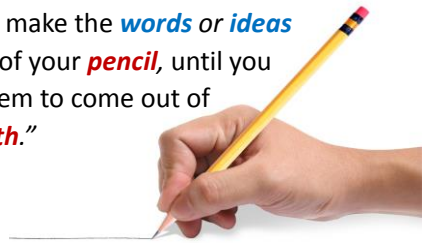
NCTM, Principles and Standards for School Mathematics

Cognitive Rehearsal

- Playing with objects and ideas, exploring and experimenting, thinking, talking, and writing become cognitive **rehearsals** (**background knowledge**) for reading.
- **Writing and reading** clarify one's thoughts, generate coherent thinking, and cultivate ***precision*** in expressing one's inner thoughts *(→ LT/P memory consolidation)*
  - **Discourse** and **writing** become cognitive **rehearsals** for assessment

Kenneth Wesson (2011). *Education for the Real World: six great ideas for parents and teachers.* Brain World, Issue 2, Volume 2.

"You can't make the ***words*** *or* ***ideas*** come out of your ***pencil***, until you can get them to come out of your ***mouth***."



Mathematics instruction for ELLs should focus on mathematical concepts by :

1. Emphasizing the connections among those concepts.
2. Using high cognitive demand mathematical tasks.
3. Maintaining high-cognitive demand throughout the lesson.

- Attending explicitly to concepts.
- Providing time to "wrestle" with important mathematics.
- Allowing students to explain their problem solving and thinking.

AERA 2006; Stein, Grover & Henningsen, 1996

Nicolas is helping to paint a wall at a park near his house as part of a community service project. He had painted half of the wall yellow when the park director walked by and said:

"This wall is supposed to be painted red."

Nicolas immediately started painting over the yellow portion of the wall. By the end of the day, he had repainted 5/6 of the yellow portion red. What fraction of the entire wall is painted red at the end of the day?

Student

- Students can monitor their own thinking.
- They are actively involved in the learning process.
- Helps students process ideas.
- Develop clearer understanding after verbalizing ideas.
- Ways to motivate and engage students in mathematics.
- They have a record of their learning.

Teacher

- We can "see" the students' thoughts.
- We gain insight into the students' understanding.
- Easily and swiftly clarify ideas.
- We can assess their skills and intervene to strengthen those skills.
- Allows us to monitor students' perceptions of the difficulty of the task.
- We can effectively address both content and process standards.

Introduction to Communication
by Susan O'Connell and Kelly O'Connor

The Role of Communication

- Communication creates greater understanding and a smoother transition to more sophisticated mathematics in middle school, high school and beyond.
- Communication elevates math to a thinking skill rather than a rote skill. It allows us to move **beyond** just doing math and push students to understand, to explore, and to explain mathematical ideas.

Something to think about….

Many will have difficulty writing in math.

Should we allow students to simply provide us with computational answers without some evidence of their thinking?

We must be challenged to find ways to enhance their skills so they can both "do math" and "tell about the math they are doing."

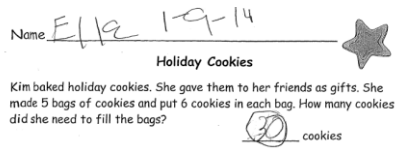
Holiday Cookies- Version 1

Holiday Cookies

Kim baked holiday cookies. She gave them to her friends as gifts. She made 5 bags of cookies and put 6 cookies in each bag. How many cookies did she need to fill the bag?

_____ cookies

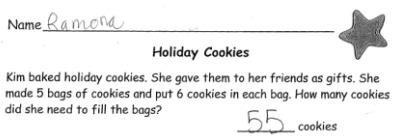
Challenge: Kim baked 3 dozen cookies. Will she have enough bags?


Name Ella 1-9-14

Holiday Cookies

Kim baked holiday cookies. She gave them to her friends as gifts. She made 5 bags of cookies and put 6 cookies in each bag. How many cookies did she need to fill the bags?

30 cookies


Name Ramona

Holiday Cookies

Kim baked holiday cookies. She gave them to her friends as gifts. She made 5 bags of cookies and put 6 cookies in each bag. How many cookies did she need to fill the bags?

55 cookies

Can you answer…

- What are the misconceptions?
- What level of understanding do the students have?
- Is there a more efficient way to solve the problem?

Holiday Cookies- Version 2

Holiday Cookies

Kim baked holiday cookies. She gave them to her friends as gifts. She made 5 bags of cookies and put 6 cookies in each bag. How many cookies did she need to fill the bags?

_____ cookies

Use numbers or pictures to show your work.

Tell how you got your answer.

_____

_____

_____

_____

Challenge: Kim baked 3 dozen cookies. Will she have enough for the bags? Tell why or why not.

Kim baked holiday cookies. She gave them to her friends as gifts. She made 5 bags of cookies and put 6 cookies in each bag. How many cookies did she need to fill the bags?

55 cookies

Use numbers or pictures to show your work.

5 bags

5 + 5 + 5 + 5 + 5 = 25

6 cookies

6 + 6 + 6 + 6 + 6 = 30

30 + 25 = 55

Challenge Problem

What is the purpose of the Challenge Problem?

What is the intended outcome?

Challenge: Kim baked 3 dozen cookies. Will she have enough bags?

Yes Cause 3 12's is much more then 30.

She has enough because a dozen is 12. 12X 3 equals 36, 30 is how many she needs so she has enough.

No because to fill 5 bags with 6 cookies it equls 30. This equls 36. She needs one more bag

No, beacuse She needs one more 6.

Can you answer…

- What are the misconceptions?
- What level of understanding do the students have?
- Is there a more efficient way to solve the problem?

1. Focus on Mathematical Reasoning
   - Uncover, hear, and support mathematical reasoning (recognize emerging)
   - Focus on mathematical meanings learners construct, not on conventional or mechanical errors

Moschkovich 2007, 2009, 2010, 2011

1. Focus on Mathematical Reasoning
2. Focus on Mathematical Practices
3. Recognize Complexity of Language in Mathematics
   - *Representations*
     - objects, pictures, graphs, words, symbols, tables
   - *Kinds of Written Text*
     - textbooks, word problems, teacher and peer explanations
   - *Kinds of Talk*
     - exploratory and expository
   - *Modes*
     - oral, written (receptive and expressive)

Moschkovich 2007, 2009, 2010, 2011

Connecting Mathematical

2. Focus on Mathematical Practices
   - Do not overemphasize single words, grammar, or lists of definitions
   - Avoid formal language requirements that may limit linguistic resources necessary for students to show/explore their understanding
   - Provide opportunities for students to use mathematical language to communicate about mathematical situations

Moschkovich 2007, 2009, 2010, 2011

Connecting Mathematical Content to Language

3. Recognize Complexity of Language in Mathematics
   - *Representations*
     - objects, pictures, graphs, words, symbols, tables
   - *Kinds of Written Text*
     - textbooks, word problems, teacher and peer explanations
   - *Kinds of Talk*
     - exploratory and expository
   - *Modes*
     - oral, written (receptive and expressive)

Moschkovich 2007, 2009, 2010, 2011

Writing to Support Understanding

- Our goal is to match the writing task with our intended learning outcome.

Writing to Support Understanding

- Students should appreciate that learning was the ultimate goal not to memorize the discreet facts and vocabulary words.
- Students should find that the new vocabulary is so useful and familiar that they begin to **use the new vocabulary words naturally** when they:
  a) **explain** their work
  b) **reflect** on their work
  c) **describe** what they do personally during the active learning process, and when they communicate their findings in the *future.*

Kenneth Wesson (2011). *Education for the Real World: six great ideas for parents and teachers.* Brain World, Issue 2, Volume 2.

Routine Writing

How can we support routine writing in math class?

Four Categories of Writing in Math

1. Keeping journals or logs
2. Solving math problems
3. Explaining mathematical ideas
4. Critiquing others thinking/justifying your own

1 Keeping Journals or Logs

"When students create ongoing records about what they're doing and learning in math class, they have a chronological record of their learning experiences."

-Marilyn Burns

What can journals look like?

Some suggestions:

- Write about what you did in class.
- What did you learn?
- What are you unsure about, confused by, or wondering about?
- Describe what was easy and what was difficult for you.

What benefit would writing prompts such as these be for teachers and for students?

Today I learned about Perimeter. Our teacher taught us how to find perimeters in shapes and when we use perimeters. It was easy because the numbers were on most of the sides to it helped me count the perimeter.

3rd Grade

Name Ally

Today I learned:

How to make fractions it was a lot of fun I hope I do this in 4th grade because I know all the other kids are going to love it.

When I think about working with fractions, I wonder

if other people like out of our class do it to like the litter kids or bigger kids to

Name Shelby

Today I learned:

that you can do fractions with and things

When I think about working with fractions, I wonder

you can do fractions with time?

Name Reese

Today I learned:

$\frac{5}{10}$ is more than $\frac{1}{2}$.

When I think about working with fractions, I wonder

How many fractions can you use?

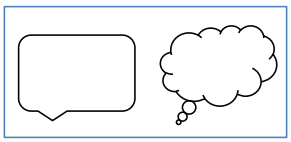
Supporting ELLs

	Casual English	Formal English
Sharing Personal Ideas or Opinions	I think… I learned that…	I decided that … I believe that … I concluded that … I observed that …
Sharing confusion or questions	I don't know… I don't get…	I don't quite understand… I wonder…. I was confused by…. I am unsure about…

I learned…

I think….

I wonder….

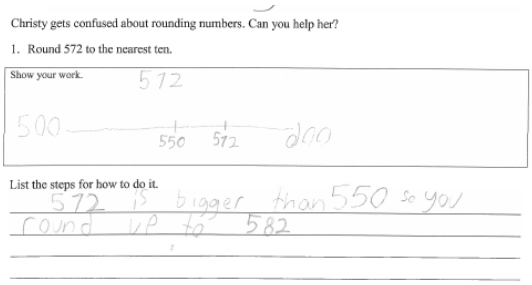


2 Solving Math Problems

- Engage in a variety of strategies.
- Monitor and reflect on their problem-solving processes.
- Communicate problem solving processes.

Although we are used to being most concerned about the "answer", if we pay more attention to how we think, it will help us to think more clearly, and improve the quality of our results.

As a teacher, looking at the students' metacognition allows us to clarify misconceptions early and assist in developing understanding.



Christy gets confused about rounding numbers. Can you help her?

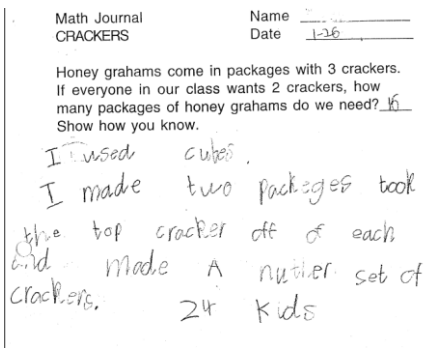
1. Round 572 to the nearest ten.

Show your work. 572

500 550 572 600

List the steps for how to do it.

572 is bigger than 550 so you round up to 582



Math Journal
CRACKERS

Name
Date 1-26

Honey grahams come in packages with 3 crackers. If everyone in our class wants 2 crackers, how many packages of honey grahams do we need? 16
Show how you know.

I used cubes.
I made two packeges took the top cracker off of each and made A nuber set of crackers. 24 kids

P. 37-40

Supporting ELLs

Reading & Understanding a Mathematics Problem

1. Students work individually on Problem.
2. Students form pairs and each pair shares one copy of the handout.
3. Pairs of students talk together to answer questions in steps 1-3 on the handout in **writing.**
4. Finally students try to act out the problem using physical objects to represent quantities in the situation.

Understanding Language: ell.stanford.edu

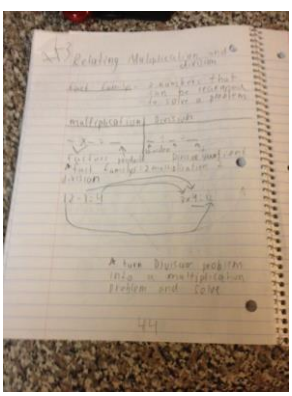
Aunt Barb's Salad Dressing Recipe
• **1/3 cup olive oil** • **1/6 cup balsamic vinegar** • **A pinch of herbs** • **A pinch of salt** **Makes 6 servings**

a. How many cups of salad dressing will this recipe make? Write an equation to represent your thinking. Assume that herbs and salt do not change the amount of dressing.

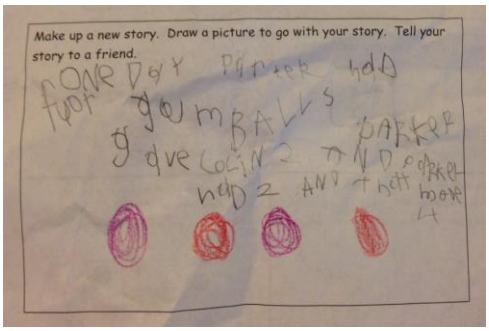
b. If this recipe makes 6 servings, how much dressing would there be in one serving? Write a number sentence to represent your thinking.

3 Explain Mathematical Ideas

- Responses provide useful information for assessing what they understand.
  - "What I know about fractions so far."
  - "What does 'equally likely' mean and give an example.
  - "Multiplication and Division—How are they alike? How are they different?"
  - "Explain the relationship between multiplication and division."



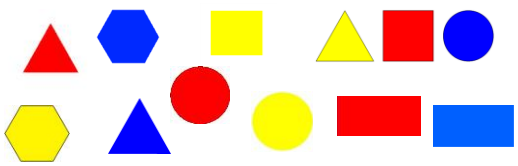
Supporting MP2



Supporting ELLs

How would you organize these objects?

In how many *different* ways could you do so?



How *could* you group these objects based on the trait circular in shape?

4 Critiquing Others Thinking & Justifying Your Own

- Why are we asking students to do this?
  - Alignment to Mathematical Practices
  - Alignment to Content Standards
  - Alignment to Assessment

ELLs and AZCCRS

1. Balance Conceptual Understanding and Procedural Fluency.
2. Maintain High Cognitive Demand.
3. Develop Productive Beliefs.
4. Engage Students in Mathematical Practices.

Understanding Language: ell.stanford.edu

Mathematical Practices

MP 1: "Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends."

MP 3: "They justify their conclusions, communicate them to others, and respond to the arguments of others."
"...—if there is a flaw in an argument explain what it is."

Content Standards

Use place value understanding and properties of operations to add and subtract.

- CCSS.Math.Content.1.NBT.C.4 Add within 100, including adding a two-digit number and a one-digit number, and adding a two-digit number and a multiple of 10, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. Understand that in adding two-digit numbers, one adds tens and tens, ones and ones; and sometimes it is necessary to compose a ten.
- CCSS.Math.Content.1.NBT.C.5 Given a two-digit number, mentally find 10 more or 10 less than the number, without having to count; explain the reasoning used.
- CCSS.Math.Content.1.NBT.C.6 Subtract multiples of 10 in the range 10-90 from multiples of 10 in the range 10-90 (positive or zero differences), using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.

Content Standards

Grade 3 Overview

Operations and Algebraic Thinking

- Represent and solve problems involving multiplication and division.
- Understand properties of multiplication and the relationship between multiplication and division.
- Multiply and divide within 100.
- Solve problems involving the four operations, and identify and explain patterns in arithmetic.

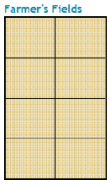
Assessment

Part B

Type a fraction different than 3/4 in the boxes that also represents the fractional part of the farmer's field that is planted with soybeans.

$$\frac{3}{4} = \frac{\square}{\square}$$

Farmer's Fields



Reset

Explain why the two fractions above are equal.

Assessment

Part B

Write $\frac{2}{10}$ as a decimal. Then write $\frac{17}{100}$ as a decimal. Explain how you can use the grids to compare the two decimals.

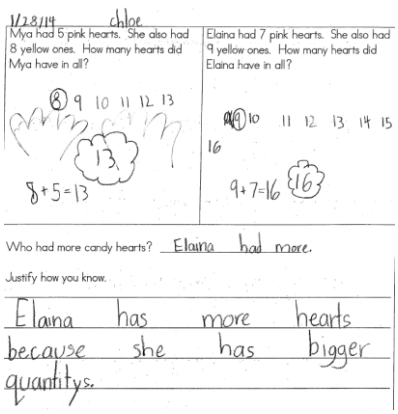
Del Back Next Save

PARCC Grade 4 Sample Item August 19, 2013

Writing Standard

Writing Standard 2:

Write informative/explanatory texts to examine a topic and convey ideas and information clearly.



1/28/14 chloe

Mya had 5 pink hearts. She also had 8 yellow ones. How many hearts did Mya have in all?	Elaina had 7 pink hearts. She also had 9 yellow ones. How many hearts did Elaina have in all?
8 9 10 11 12 13	10 11 12 13 14 15 16
13	16
8+5=13	9+7=16

Who had more candy hearts? Elaina had more.

Justify how you know.

Elaina has more hearts because she has bigger quantitys.

P. 47-49

Supporting ELLs

Mathematically Speaking

1. Student pairs are formed.
2. Target words are written on the *Mathematically Speaking* chart (class, student, teacher).
3. Both students write their names across the top.
4. One at a time each student explains their solution to their partner as he or she tallies each time a target word is used in the explanation.
5. Partners cue each other to elaborate on their response until all the target words have been used at least once.

Understanding Language: ell.stanford.edu

Nicolas is helping to paint a wall at a park near his house as part of a community service project. He had painted half of the wall yellow when the park director walked by and said:

"This wall is supposed to be painted red."

Nicolas immediately started painting over the yellow portion of the wall. By the end of the day, he had repainted 5/6 of the yellow portion red. What fraction of the entire wall is painted red at the end of the day?