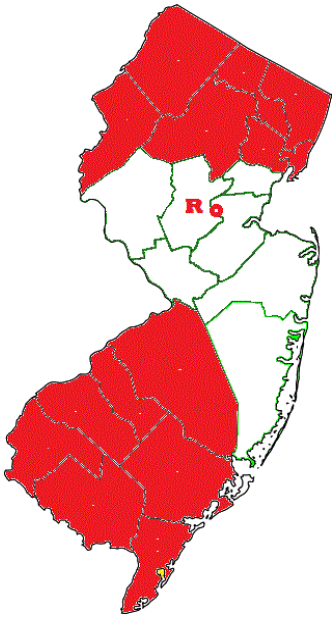


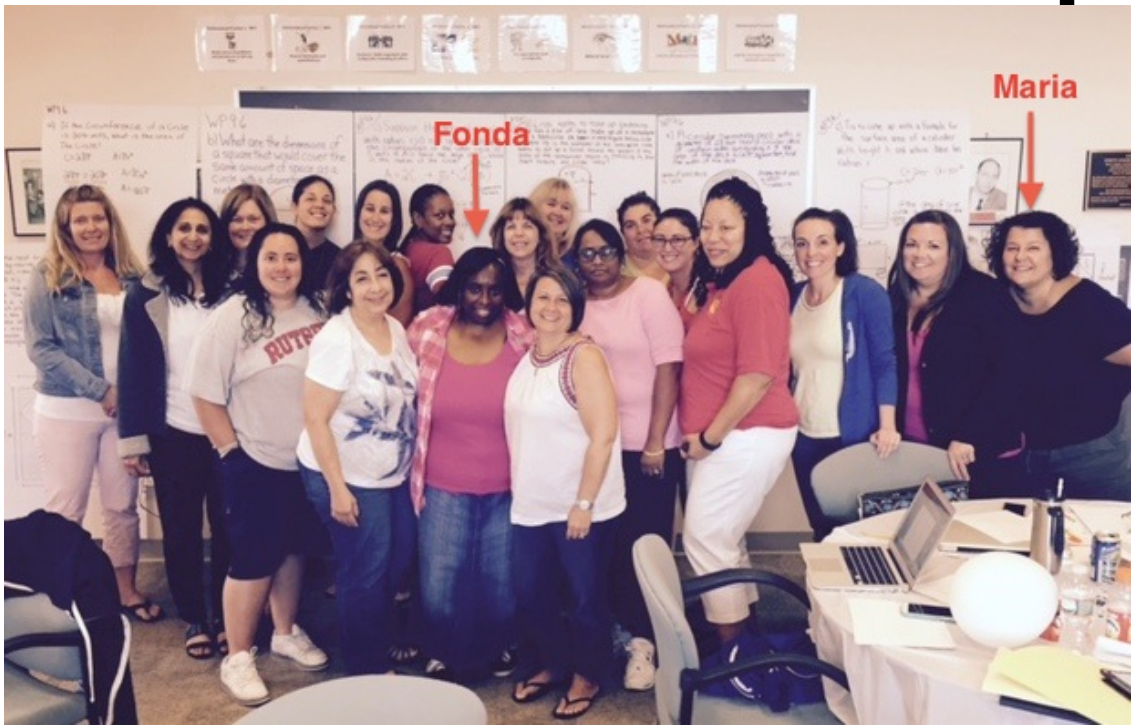
RUTGERS
NEW BRUNSWICK

The Central New Jersey Partnership to Enhance Mathematics Achievement
CNJ-PEMA

What Can Elementary Mathematics Teachers Learn From Interviewing Their Students?

A presentation prepared for the
2015 NCTM Regional Conference -
Nashville, TN
November 18-20, 2015

CNJ-PEMA Partnership



Rutgers University

Partner School Districts

Franklin Township

North Brunswick Township

New Brunswick

Why Focus on Questioning?

"…teachers who press students with strategic questions and carefully monitor their answers can move pupils to genuine mathematical argument and reasoning…"

(http://digitalarchives.wa.gov/WA.Media/do/69B564EC83658571A2ABBF7F31585523.pdf)

Why Focus on Questioning?

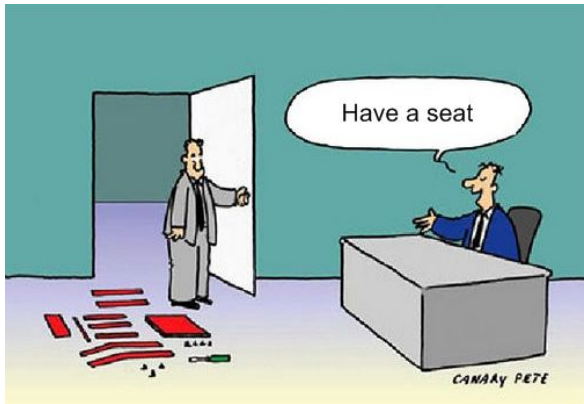
"…up to 80 percent of teachers' interactions with students include questioning (Fillippone, 1998). During math discourse, questioning should challenge students to be inquisitive and help them extend their existing mathematics knowledge—for example, "Why does this work?" "Is there a more efficient way of doing that?" and "Does this work in every case?" (Schwols & Dempsey, 2012b)." (Kirsten Miller, ASCD)

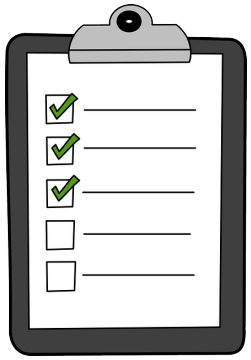
Why Focus on Questioning?

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.

Clinical Interview: Main Points

- Flexible method for finding out what students think and believe about the world.
- Allows for interpreting student's thinking, strategies, reasoning abilities.
- Can give dramatic insight into how a student's world is different from an adult's world.
- Encourages student's thinking. It makes the adults think, too.



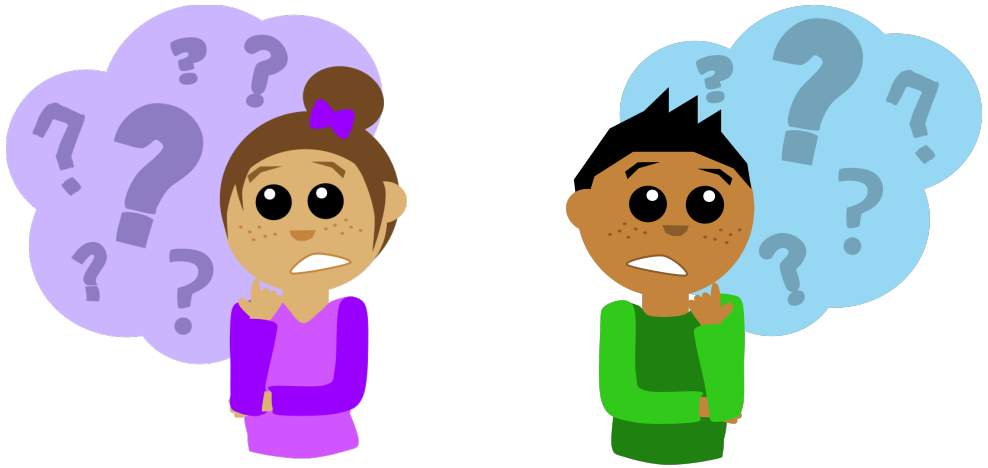


Checklist for the Successful Interviewer

- Prepare a protocol
  - Leave room for flexibility.
  - Choose “appropriate” tasks.
- Put the student in the role of expert.
- Ask for justifications (whether a solution is right/wrong).
- Avoid unnecessary corrections and teaching.

Fundamental Questions

- Tell me how you did that.
- Does that always work? Why or why not?
- What would happen if…?
- How could you explain this to someone who was absent from class? To a younger student?

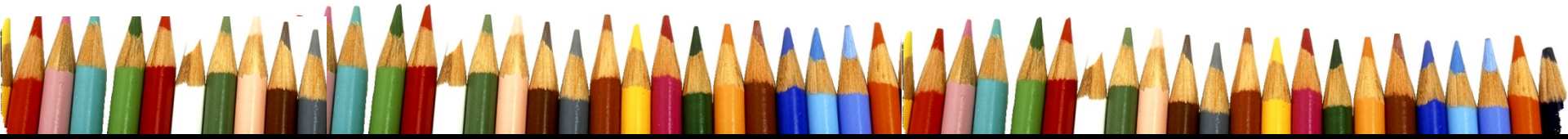


Fonda Dortch-Taylor

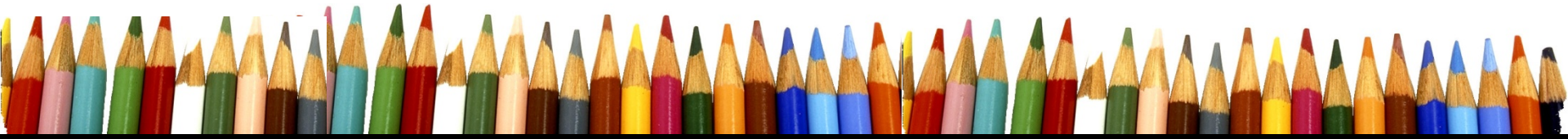
Students' understanding of the equal sign

DEFINED

The symbol = Shows that what is on the left of the sign is equal in value or amount to what is on the right of the sign.



HOW DO STUDENTS VIEW THE EQUAL SIGN?

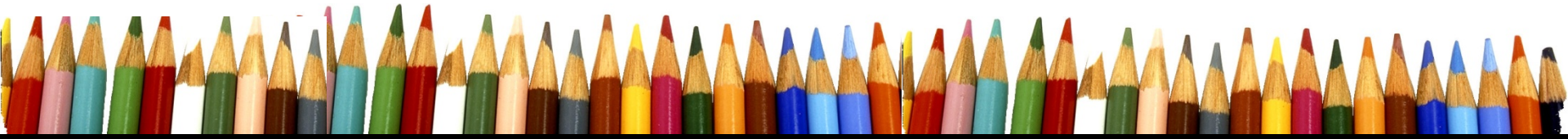


First, Third & Fourth Grades

Tenth and Twelfth Grades

MISCONCEPTIONS

- The answer to the problem
- Sum
- Difference
- Total amount
- How much is left
- Adding
- Put two numbers together



MISCONCEPTIONS

Cameron: 7 + 6 = 18 + 5

Teacher: *Cameron, what number did you put in the box?*

Cameron: *Eighteen*

Teacher: *How did you decide?*

Cameron: *7 and 6 are 13 and 5 more is 18*

Teacher: *Does 7 plus 6 equal 18 plus 5?*

Cameron: *7 + 6 is 13 and 5 more is 18*

Luke: 7 + 6 = 13 + 5

Teacher: *Luke, what number did you put in the box?*

Luke: *Thirteen*

Teacher: *How did you decide?*

Luke: *7 and 6 are 13*

Teacher: *What about the 5?*

Luke: *It doesn't matter. The answer to 7 + 6 is 13*

Teacher: *What is the 5 doing then?*

Luke: *It's just there.*

Chris: 7 + 6 = 8 + 5

Teacher: *Chris, what number did you put in the box?*

Chris: *Eight*

Teacher: *How did you decide?*

Chris: (Points to the numbers) 7 + 6 = ☐ + 5

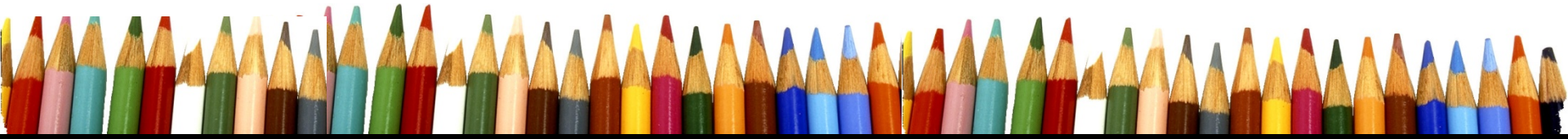
5 is one less than 6, so you need a number that is one more than 7 to go in the ☐ so it all balances.

WHERE DO WE GO FROM HERE?

It is imperative that teachers on all levels reconsider how they teach equality.

=

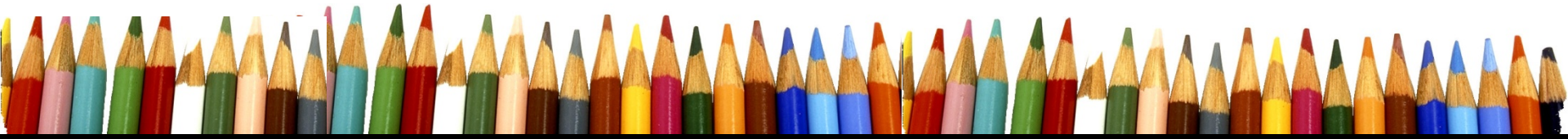
means the same as. It does not mean the answer is on the right side.



LEARNING TARGETS

The following should serve as learning targets when teaching equality:

- Students will be able to explain that the equal sign means "same as."
- Students will be able to compare the value of both sides of an equation and determine whether the equation is true or false.
- Students will know that an equal sign represents the relationship between two equal quantities.
- Students will know that the quantities on both sides of the equation are equal in value.



Maria Russo

Assigning fraction names

Standard: CCSS.MATH.CONTENT.5.NF.A.2

Solve word problems involving addition and subtraction of fractions referring to the same whole, including cases of unlike denominators, e.g., by using visual fraction models or equations to represent the problem. Use benchmark fractions and number sense of fractions to estimate mentally and assess the reasonableness of answers. *For example, recognize an incorrect result 2/5 + 1/2 = 3/7, by observing that 3/7 < 1/2*.

Figure 1

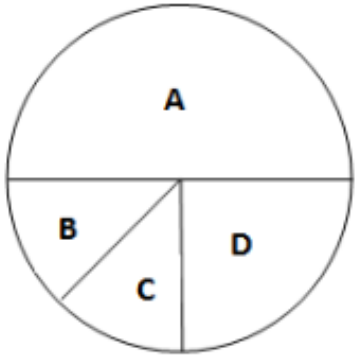


Figure 2

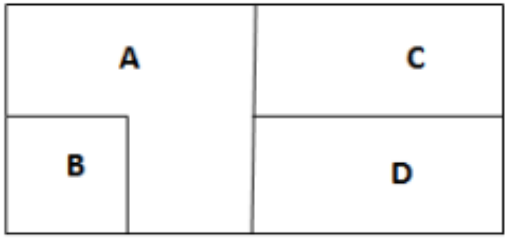
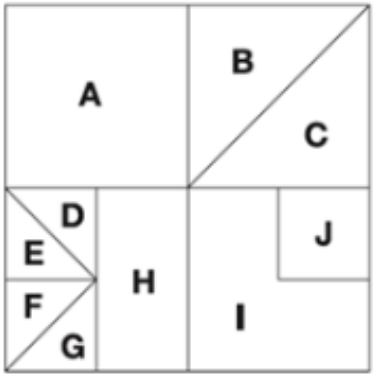


Figure 3



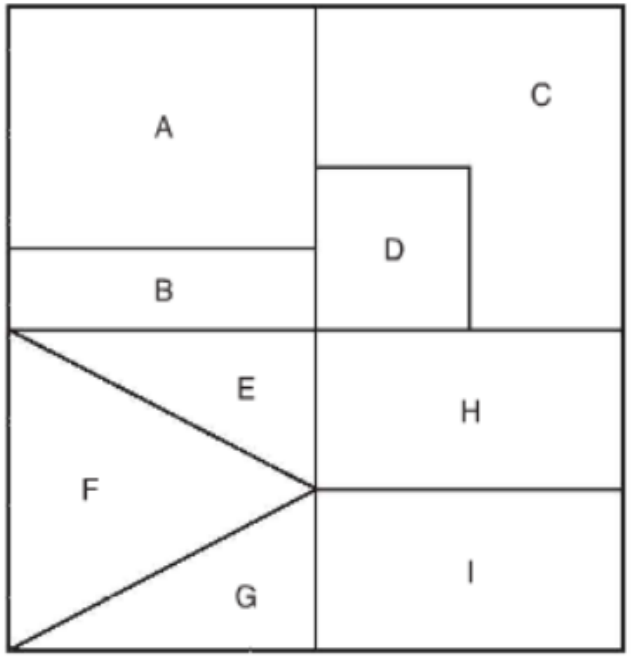
End of Unit Assessment

Finding Fractions

The figure below represents One.

Find and write the correct fraction in each of the figure's parts.

Check to be sure that the sum of the fractions is 1.



Explain how you found the fraction for the part labeled F.

What students would need to know about fractions:

- Fractions are numbers that can be added, subtracted, multiplied and divided
- Fractions are divisions of a whole. The more divisions, the smaller the pieces
- Fractional parts need to be equal in size
- Different fractional names can be given to equivalent parts
- The value of any fraction in a model is dependent on the value of the whole. If the whole changes, so does the value of each fractional part.

The Interview

Figure 1

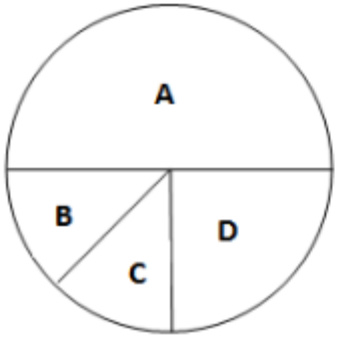
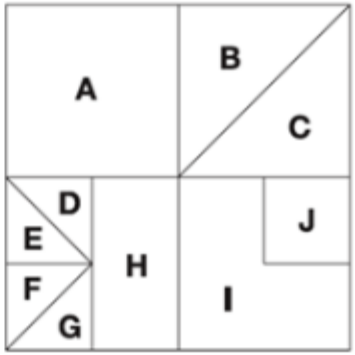
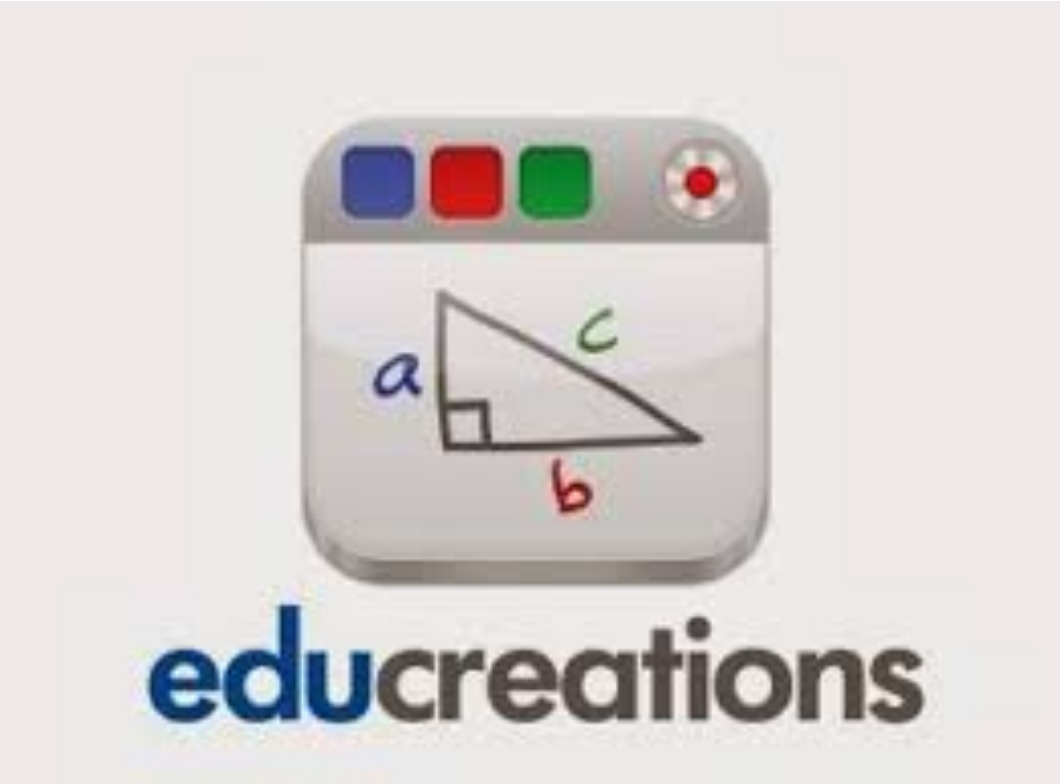


Figure 2

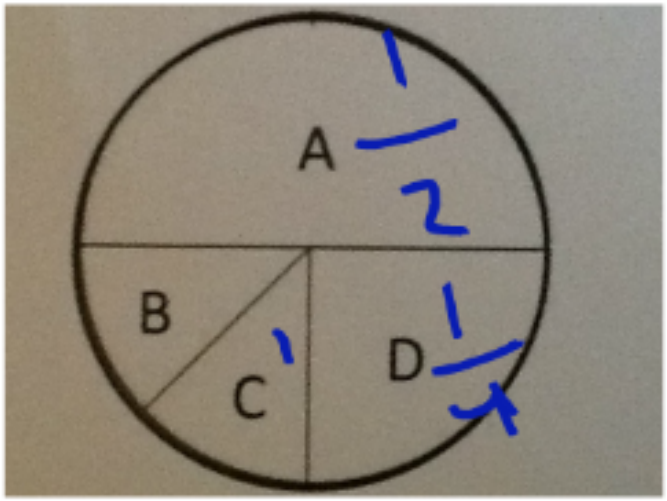
Figure 3



Educreations Application for iPad

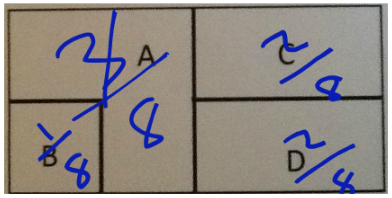


What I learned:

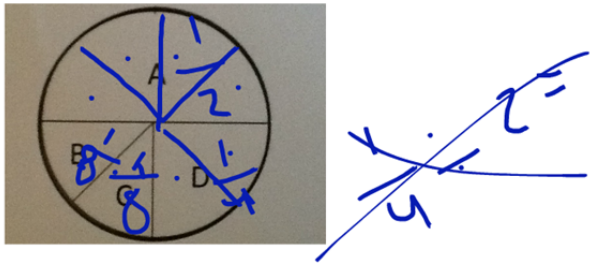


"I know I need to break 1/4 into 2 pieces"

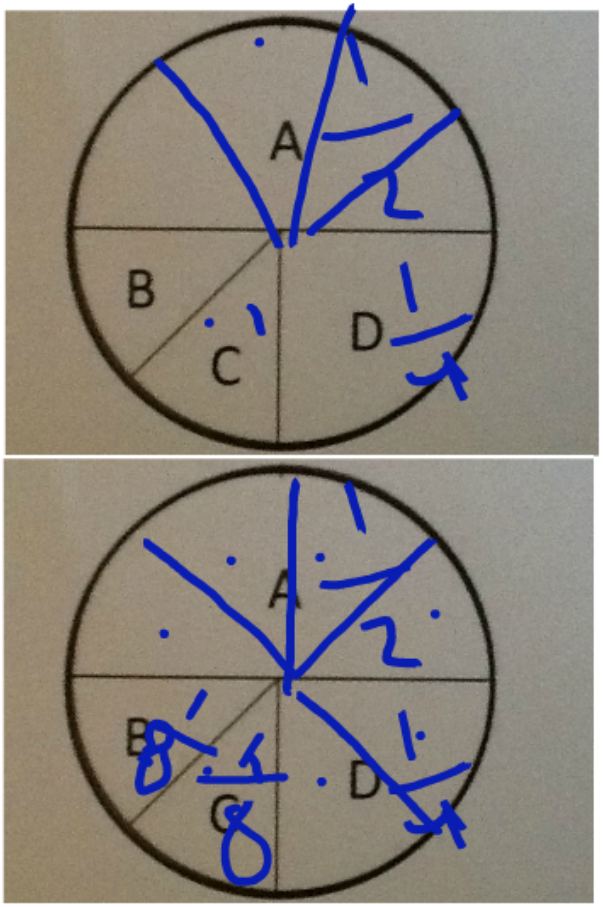
"I don't know what this part would be (C) if I took this part (B and C) and split it into 2 pieces"



" Can you erase?"

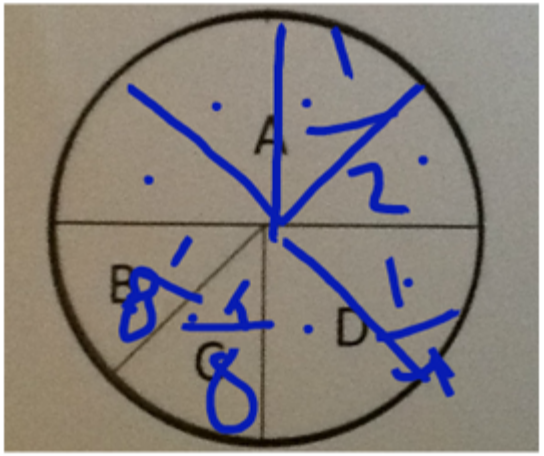


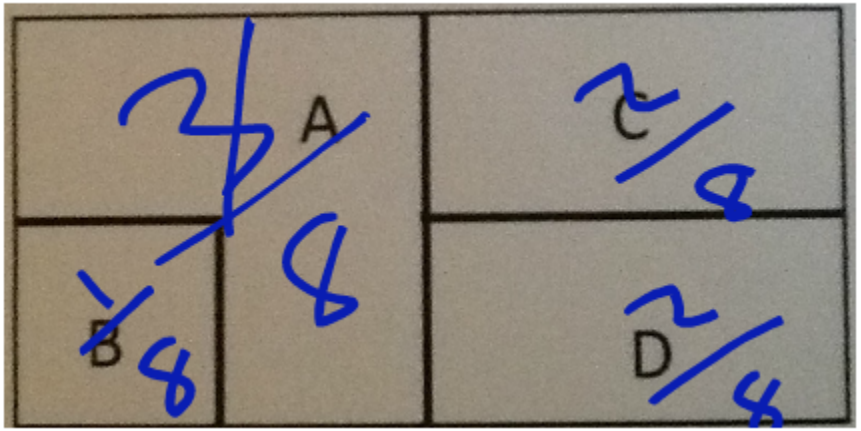
"*That (B) would be 1/8 because the circle could be split up into 8 little triangles of the same size as B and C. And they're (B and C) each one triangle so it would be 1/8 because there's 8 of them when you split them up in the cirlce."*



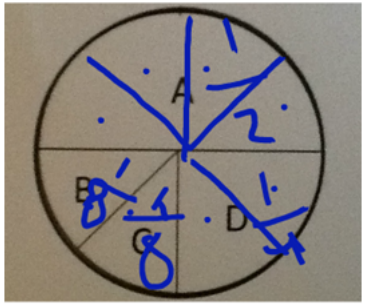
1:20-3:45

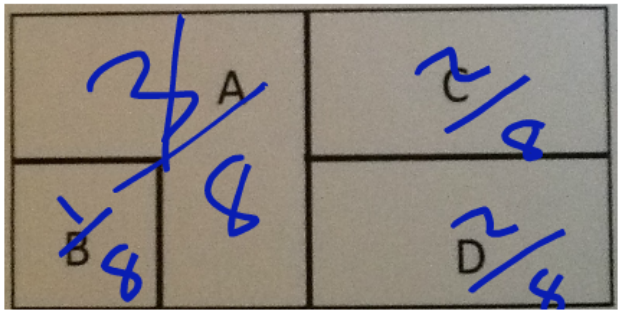
The Unit Fraction



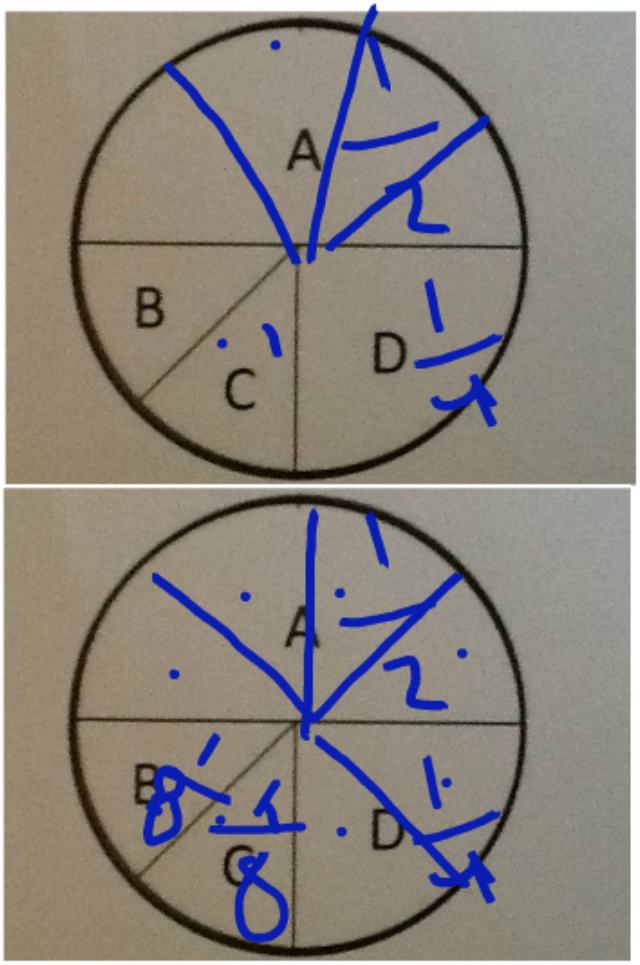


Wrong to Assume

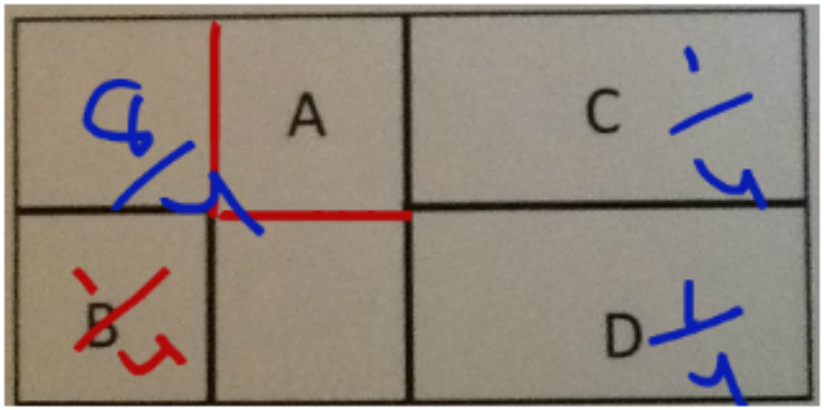


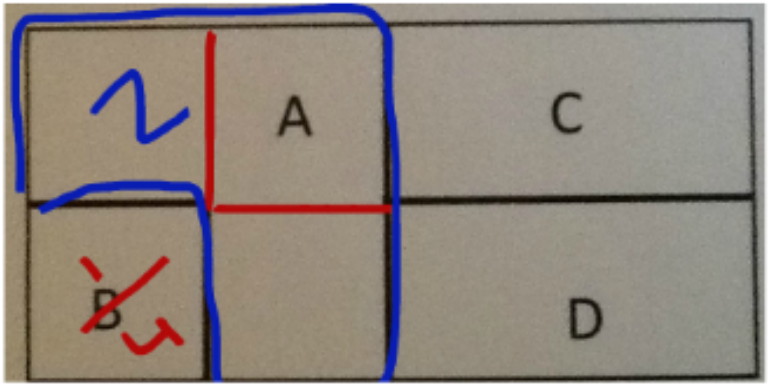


Understanding the “Whole”



Losing the Whole

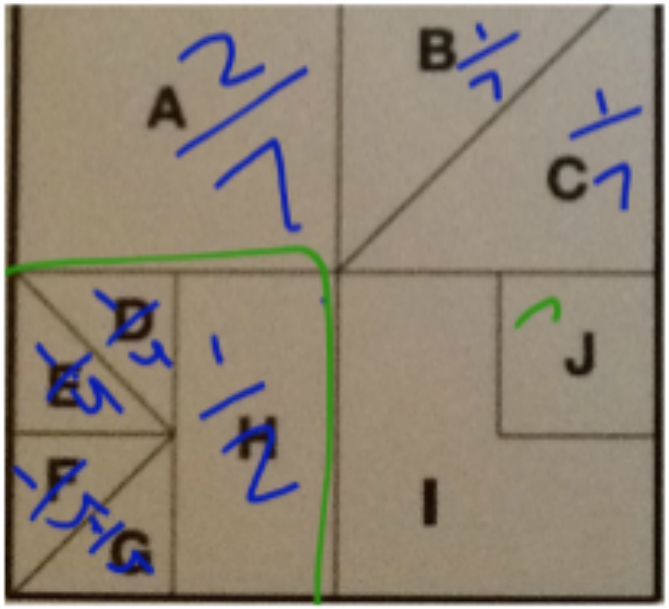




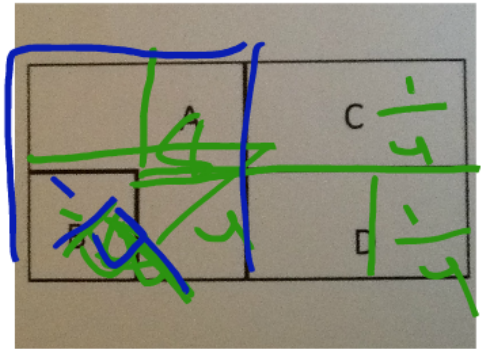
Losing the Whole

“D, E, F, and G are each ¼ because there are 4 of them.”

“H is ½ because it is half of this box (outlined in green)”



Wait Time and the urge to “Jump In”



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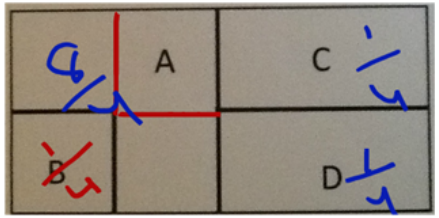
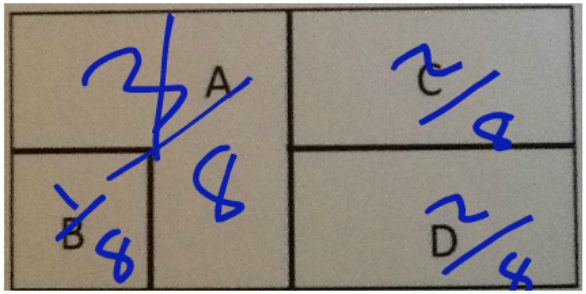


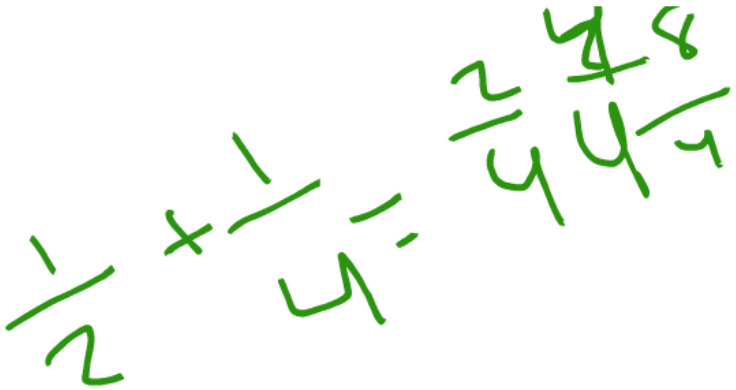
10:12



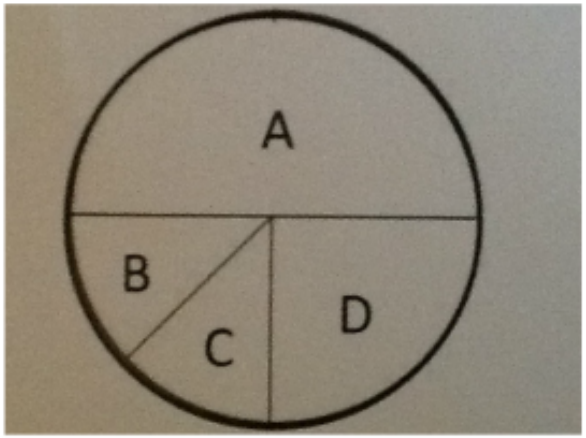
11:35

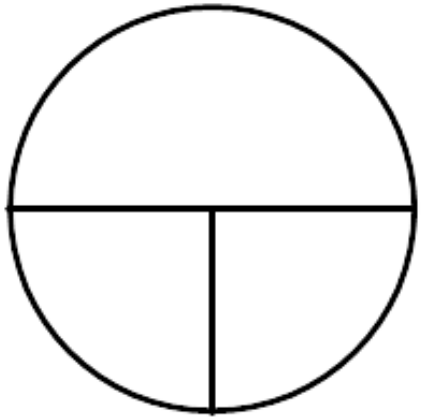
Computation Situation

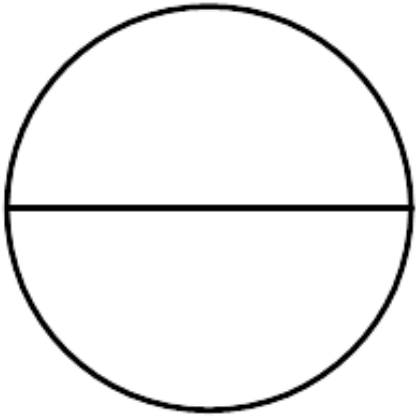
Computation Situation



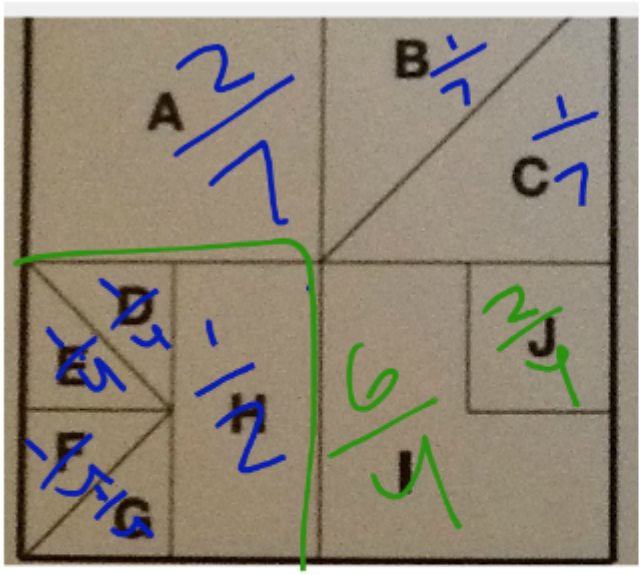
Baby Steps







One thing leads to another...



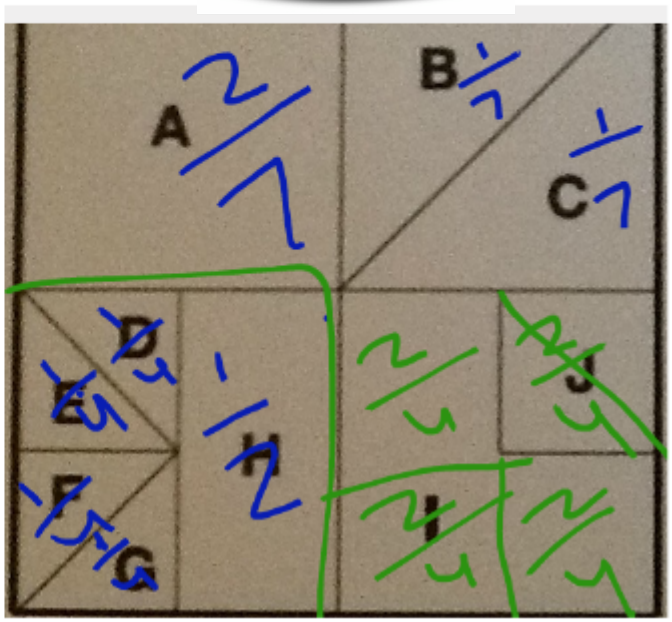


Figure 1

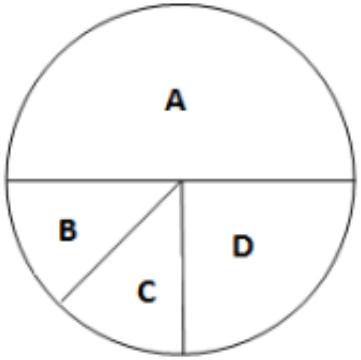


Figure 2

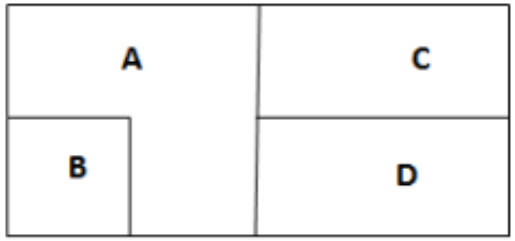
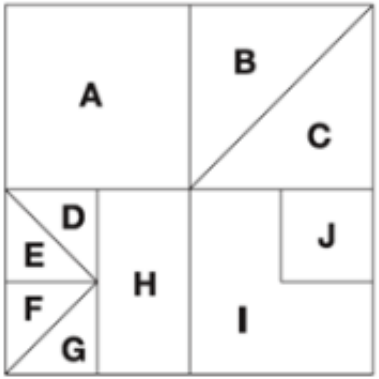


Figure 3



16:00 - end if time allows

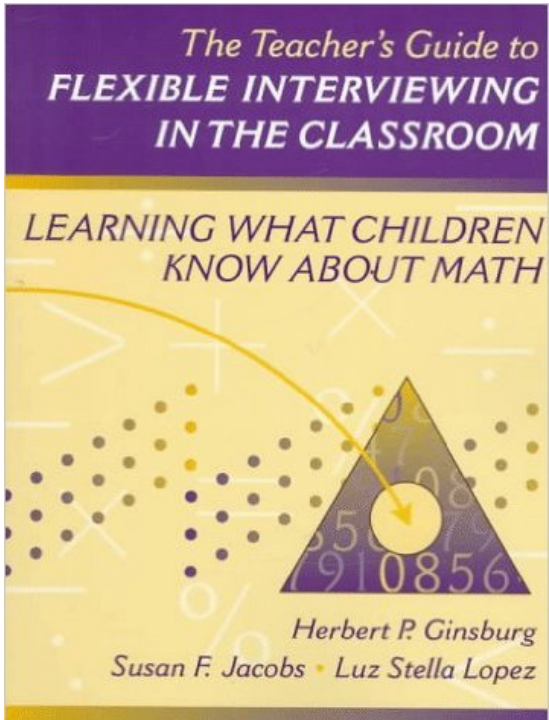
Selecting Rich Mathematical Tasks

Curriculum Materials

- Go Math (New Brunswick), Everyday Math (North Brunswick), Go Math & engageNY (Franklin Twp.)

Teacher's Guide to Flexible Interviewing in the Classroom (Ginsburg, Jacobs, & Lopez, 1998)

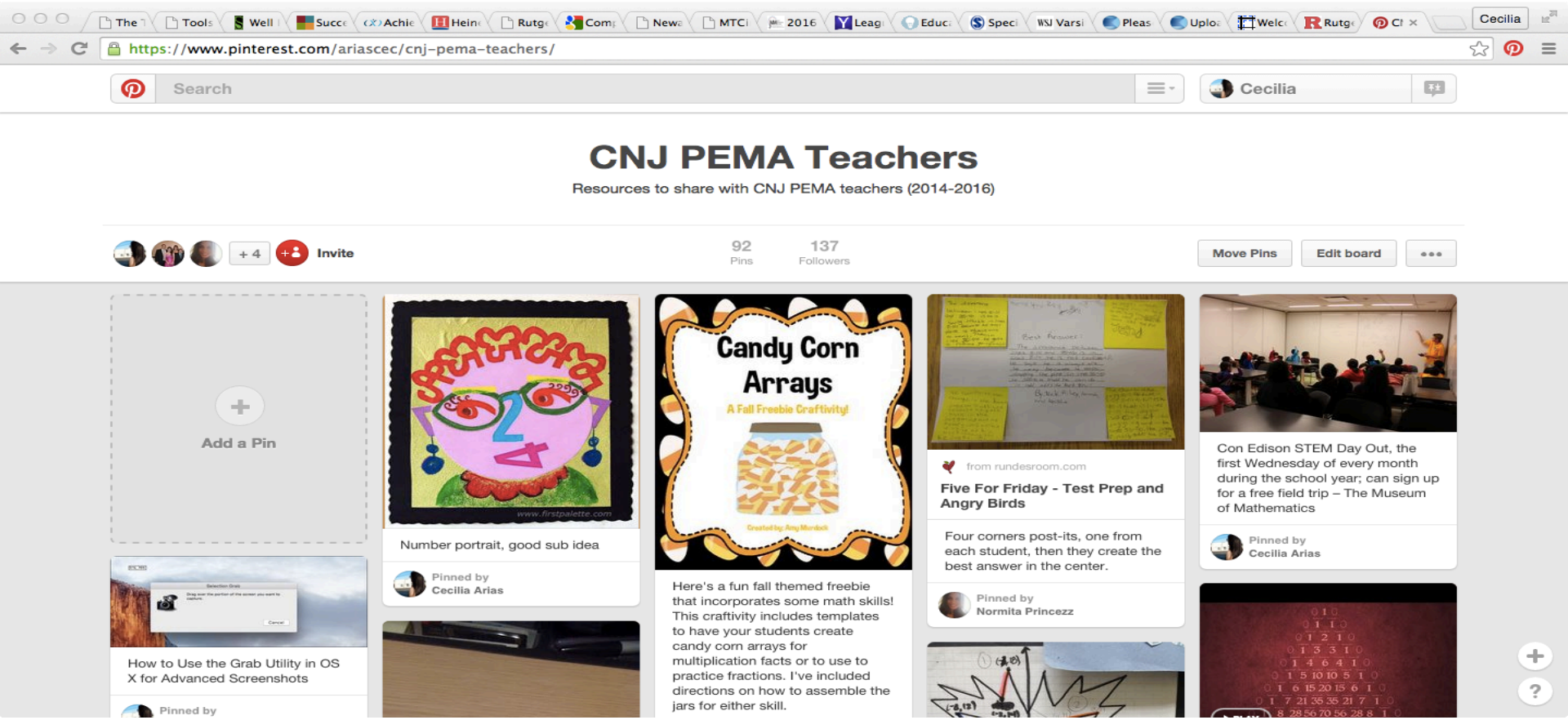
- *"Suppose that your friend said that $3.00 minus 65 cents is $2.45. Can you find your friend's error? Why do you think that error was made? How could you help your friend understand how to find the correct amount?"*
- Counting, place value, operations, prime and composite numbers, fractions, ratio, percent, decimals, geometry



Selecting Rich Mathematical Tasks

Pinterest (we pin with our PEMA teachers!)

- https://www.pinterest.com/ariascec/cnj-pema-teachers/
- https://www.pinterest.com/ariascec/classroom-questioning-techniques/

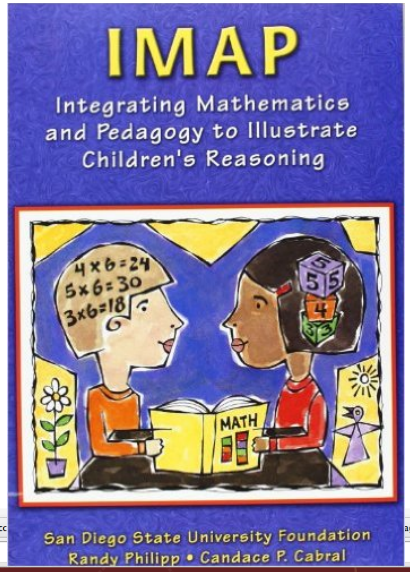


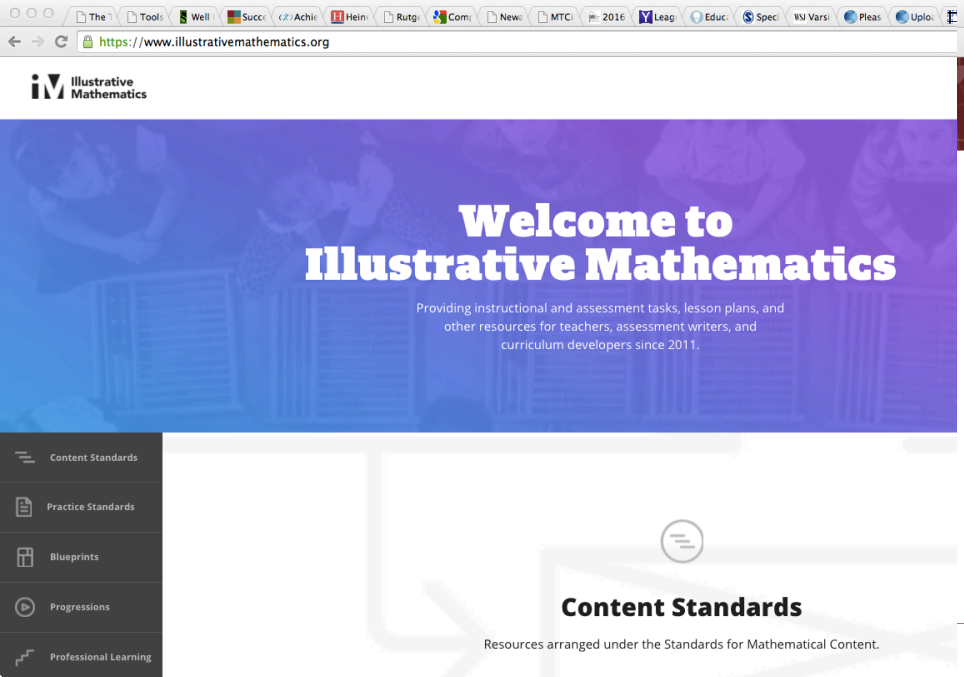
Selecting Rich Mathematical Tasks

[Illustrative Mathematics](https://www.illustrativemathematics.org)

[Mathematics Assessment Project](map.mathshell.org)

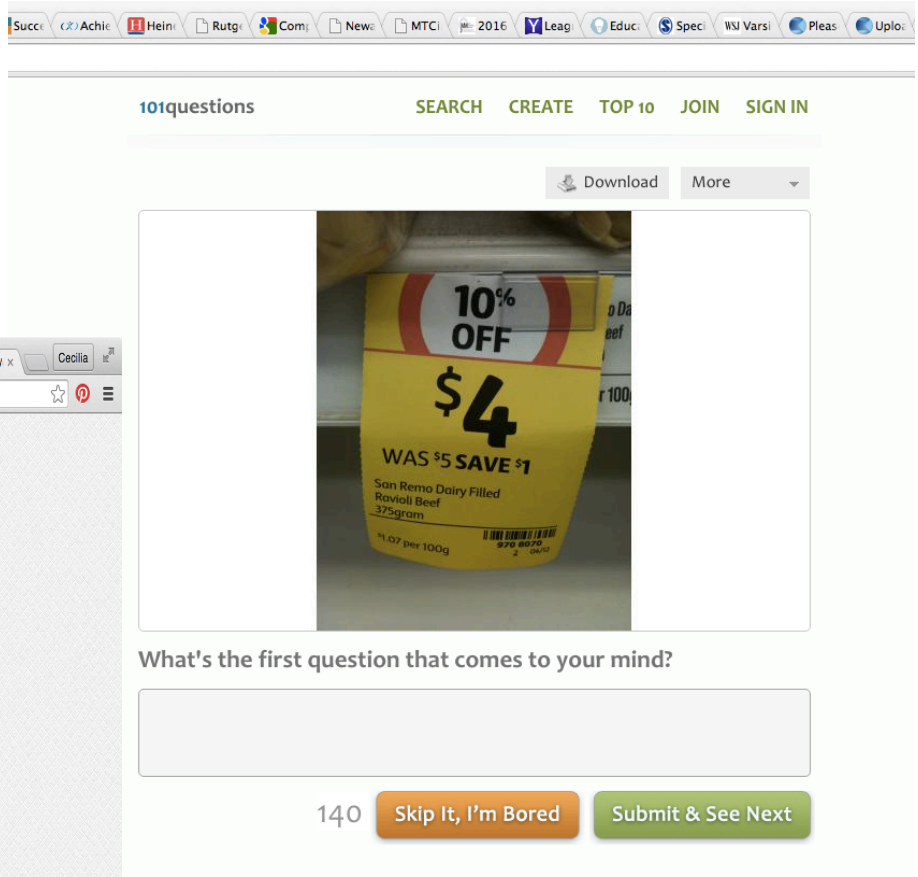
IMAP

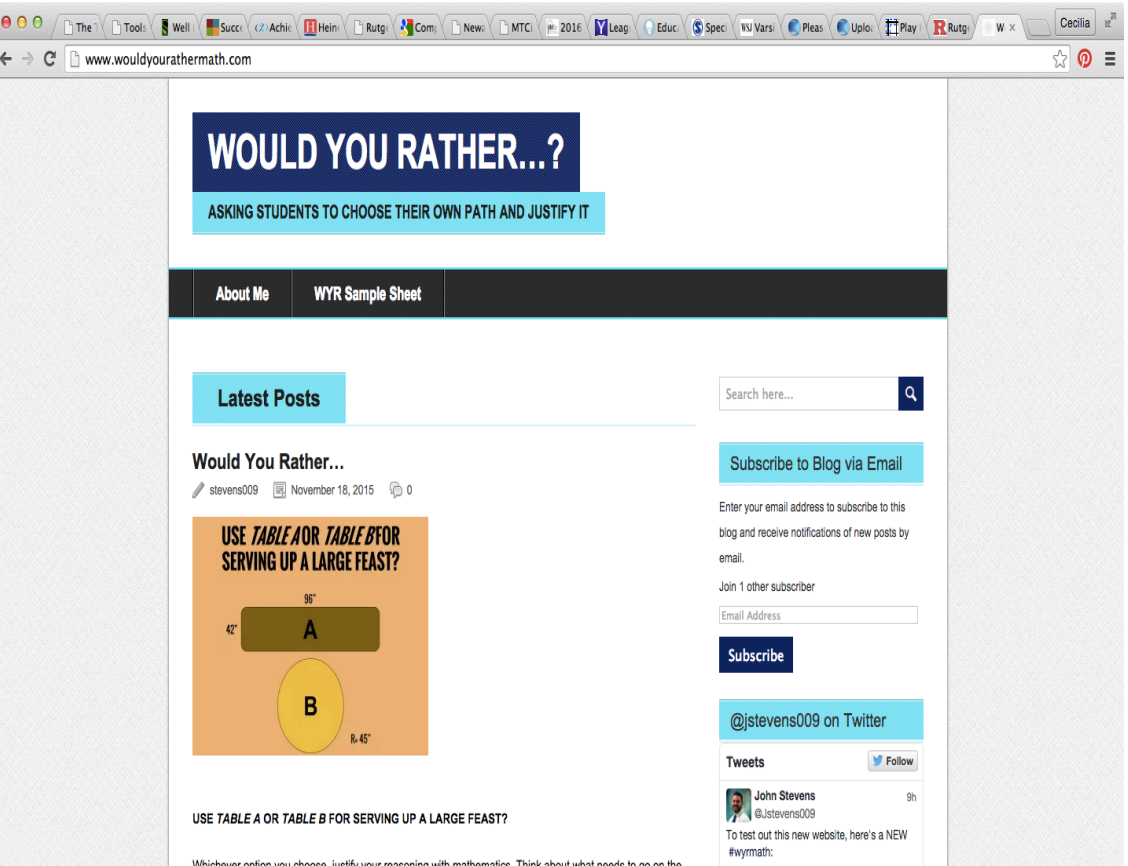




Selecting Rich Mathematical Tasks

- 101 Questions
- Would You Rather…?





Considerations for Incorporating the Clinical Interview Method

As part of coursework for pre-service teachers

- Focus on questioning
- Focus on listening
- Discuss how thinking of students' may differ from their own thinking

As part of a professional development program for teachers

- Discuss purpose of interview (to gather information, not to teach)
- Focus on questioning
- Discuss what to do with information gathered from interview

Questions and Comments

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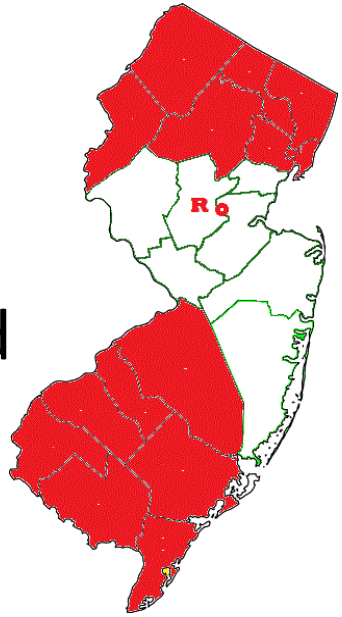

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