

## The Math Things Mingle

7th grade mathematics lesson  
Willard Middle School  
to be taught by Jake Disston  
Thursday January 22, 2009

**Mathematical Topic:** Algebraic Symbol Strings – Making sense of the differences between equations, inequalities and expressions.

### Lesson Objectives:

- To have students sort and classify various types of equations, inequalities and expressions.
- To help students develop instincts and vocabulary for describing, discussing and working with equations, inequalities and expressions.
- To give students an opportunity to discuss and express what they know about various mathematical objects without providing a script or a procedure for them to follow.

### Lesson Background:

Our lesson study group began the year by creating a list of big ideas that we feel students need to be comfortable with in order to succeed in 8<sup>th</sup> grade Algebra. We deliberately focused on ideas that were big and conceptual and which from our perspective reached across specific standards and through the middle school grades, rather than focusing on specific skills or procedures described in one particular standard and belonging to one grade level. We distilled our list down to four ideas that we felt were essential for students to have significant experience with and of which they should have a strong understanding by the end of 7<sup>th</sup> grade:

- variables
- equality
- operations
- different types of numbers

This year our district adopted a new text book published by Holt. In our lesson study group, our discussions this year have largely focused on the need to balance the procedurally based material presented in the text book with opportunities for students to make sense of the big ideas in a way that enables them to both ground their mathematical understanding in the context of their own lives, and to make connections between ideas so that the knowledge they are building is coherent. Our discussions and work have also been influenced by the pedagogical practices associated with the Center For Culturally Responsive Teaching and Learning, an organization that is providing professional development at our school aimed at helping teachers incorporate routines and activities that enhance the engagement of African American and Latino students and ultimately reduce the achievement gap that is so apparent at our school.

Our lesson is adapted from an activity that Ann Lawrence presented at the 2007 California Math Council Conference at Asilomar. The activity is called "See what your kids know" and presents students with a set of 12 cards, each containing a mathematical symbol string – equations, including single and double variable equations, formulas, identities, and also expressions. Students are asked to sort the cards into sets that make sense to them, to describe the attributes that the items in the set share, and to create new examples that fit within each of the sets.

We like the activity in that it creates an opportunity for students to apply their own understanding and language to work with a variety of mathematical objects simultaneously, rather than presenting a single idea and dictating what students do and how they do it, as typical text book activities do. Our plan tries to address two main concerns that we have: 1) that we create a set of cards that are appropriate for 7<sup>th</sup> graders and which highlight the mathematical concepts of variable and equality, and 2) that we create a structure in which all students can become engaged, and that the teacher fosters a discussion in which students articulate their understanding of the ideas and connections between them that go deeper than just surface level, trivial observations at which students often stop.

### Our Lesson:

We will start by passing a card to each student. Each card will contain a single symbol string – an equation, an inequality or an expression. Students will be asked to stand up and mingle with each other, trying to find all the other students who have a symbol string that they feel is similar to their own. The

teacher will circulate, encouraging students to explain what they are seeing and how they are grouping together.

Once students have grouped together into sub-sets, the teacher will call all students to the board for a huddle. On the board there will be set of the same cards. The teacher will foster a discussion in which students share their initial thoughts about the cards and the subgroups into which they can be sorted. The object of this huddle will be to allow the class to come to some consensus about the sorts of attributes that are important in sorting and distinguishing the various symbol strings, and ultimately to establish at least the three 'top level' sub groups: equations, inequalities and expressions.

Next students will be asked to sit at a table with other students with the same 'top level' type of card. The teacher will collect these cards, and will pass out a complete set of cards to each group and ask students to sort the whole deck into the 'top level' sub-groups. Once they have completed the first sort they will be asked to answer a reflection question on their activity recording sheet: 1) how can you tell the differences between equations, inequalities and expressions?

Next groups will be asked to focus on the differences between cards within each category. Each group will be asked to start with their own 'top level' type (ie: the equations groups start with equations, inequalities start with inequalities, and expressions start with expressions). The teacher will ask them to think about how some equations are alike other equations and different from some others. As groups engage in the second sort and discussion, the teacher will circulate around the groups to ask probing questions aimed at helping students formulate their thinking about the similarities and differences among sets of similar symbol strings.

We expect that students may sort the cards in many ways, paying attention to both mathematically important attributes (eg: "these equations have single solutions and these equations have many equations") and mathematically trivial attributes (eg: "these equations include a's and b's and these include x's and y's"). We designed the cards to include many differences that we hope students will notice and describe, including:

within equations:

- equations that have unique solutions
- equations that represent number patterns or 'properties'
- equations that represent common formulas (eg:  $A=LxW$ )
- multi step equations
- constant equations

within inequalities:

- strictly greater than and strictly less than inequalities
- greater than or equal to (and less than or equal to) inequalities
- inequalities in which the sign switches direction when solved
- compound inequalities

within expressions:

- simplified expressions
- un-simplified expressions
- rational expression

The teacher will lead a discussion in which groups will report their ideas to the class, and the class will be invited to ask questions and make comments and suggestions. Students will be invited to use the set of cards on the board in order to enhance the discussion.

Next students will be asked to work with their group to write a second reflection on their activity reporting sheet: 2) "Explain what subcategories you noticed. What distinguishes the symbol strings that fit in each subcategory? List each symbol string that fits within each subcategory."

Finally, groups will be asked to make up at least 6 new examples of symbol strings that fit within one of the subcategories. They will be asked to write them on an index card, and to write the name of the 'top level' group and subcategory description on the back.

### Research Question:

- What evidence is there that students are able to see these symbol strings as more than just collections of letters, numbers and operations? What evidence is there that students are developing instincts about these things, and an understanding of the attributes and features of the symbol strings which will be utilized in 8<sup>th</sup> grade algebra?

# Sorting Symbol Strings

## Activity Recording Sheet

Name \_\_\_\_\_

1. What are the differences between Equations, Inequalities and Expressions? Write as much as you can to explain what you know about how they are different.

2. Describe the subcategories you noticed within each group. What is alike about all the symbol strings that fit in a particular subcategory? Make sure to list all symbol strings that fit in each subcategories.

3. With your group, make up at least 6 new symbol strings that fit within the subcategories. List them here **AND** write each one on the front of an index card with a description of the subcategory on the back of the index card.

$$4x + 2 \leq 18$$

$$2x \geq 16$$

$$5x - 1 \geq 34$$

$$B - 2 > 0$$

$$\frac{m}{5} > 20$$

$$X - 7 < 5$$

$$3x + 2y + 2x$$

$$3a - 2b + 4c - a$$

$$4p + 3p - 2p$$

$$5(x + 2)$$

$$3b + 4p + 17$$

$$3x + 2y + 4z$$

$105 + 2a = 101$	$3x + 2x = 5x$
$a + (b + c) = (a + b) + c$	$F \cdot 1 = F$
$X + Y = Y + X$	$V(W + X) = VW + VX$
$3 + 2n = 8$	$40 = 5x$
$y = 2$	$x = \underline{\quad}$
$A = L \cdot W$	$P = 2W + 2L$

$$-4m \leq 8$$

$$3x - 4 \leq -8$$

$$2 - p > 7$$

$$\frac{m^2 \cdot m^4}{m^3}$$

$$\frac{3p + 7m}{4n - 6}$$

$$\frac{(4a)^3 \cdot 2m}{6a^4 \cdot m^2}$$