3rd grade public research lesson on May 22, 2004
at the National Teachers Academy Professional Development School

Mathematics Lesson Plan for Grade Three

For the lesson on May 22, 2004
At National Teachers Academy, Ms. Taylor's class
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Unit plan developed by: Chicago Lesson Study Group
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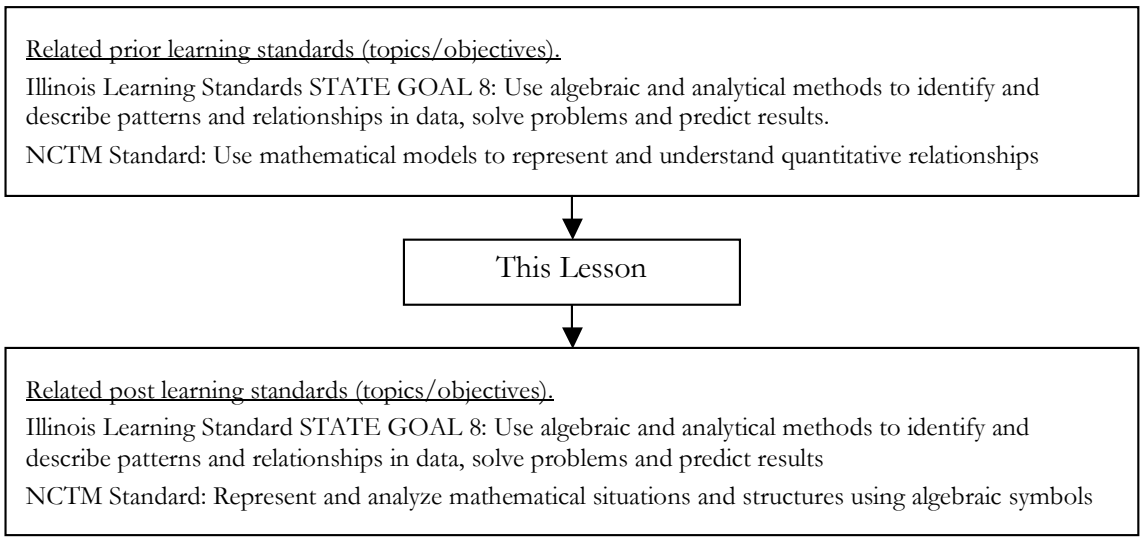
"Caterpillar Connections" 

1. Title of Unit: Developing algebraic reasoning through problem solving.
   Goal of the Lesson
   To deepen students' understanding of the concept of multiplicative reasoning.
   To provide opportunities for students to recognize the importance of working with their peers in order to deepen their understanding of mathematics.
   To provide opportunities for students to verbally express their mathematical thinking through problem solving.
   Relationship of the Lesson in the Illinois Learning Standards for Mathematics and the Principles and Standards for School Mathematics (NCTM 2000)



Instruction of the Lesson

Although *algebra* is a word that has not commonly been heard in grades 3–5 classrooms, the mathematical ***investigations and conversations*** of students in these grades frequently include elements of algebraic reasoning. These experiences and conversations provide rich contexts for advancing mathematical understanding and are also an important precursor to

the more formalized study of algebra in the middle and secondary grades. In grades 3–5, algebraic ideas should emerge and be investigated as students—

identify or build numerical and geometric patterns;
describe patterns verbally and represent them with tables or symbols;
look for and apply relationships between varying quantities to make predictions;
make and explain generalizations that seem to always work in particular situations;
use graphs to describe patterns and make predictions;
explore number properties;
use invented notation, standard symbols, and variables to express a pattern, generalization, or situation.

In this lesson students will investigate numerical and geometric patterns and express them mathematically in words or numbers. They should analyze the structure of the pattern and how it grows or changes, organize this information systematically, and use their analysis to develop generalizations about the mathematical relationships in the pattern.

In grades 3–5, multiplicative reasoning should become a focus. Multiplicative reasoning is more than just doing multiplication or division. It is about understanding situations in which multiplication or division is an appropriate operation. In this lesson students use multiplicative reasoning to discover equivalent shapes using different pattern blocks. Using the hexagon caterpillar as an instructional model, students will build on the thinking of others and expand the domain of their inquiry through conversations with classmates.

It is our understanding that math cannot be fully understood or learned well without practicing. Algebra is no different. If you just remember all the rules and procedures without truly understanding the concepts, you will no doubt have difficulty learning algebra. Algebra can begin to make sense with the determination to take small steps, practice and increase the difficulty in the types of equations you solve in a step-by-step sequential process.

Sometimes it helps to treat algebra like driving a car. You learn to drive with practice and there are certain rules to follow, knowing the rules makes driving easier and you avoid making mistakes. Algebra requires you to apply certain rules and the better you become at following the rules - which takes practice, the better you become a solving algebraic equations.

In this lesson students will be engaged in problem solving, reasoning, decision making, and applying solid strategies etc. Algebra provides you with a wonderful grounding in those skills - not to mention that it can prepare you for a wide range of careers. Algebra is a great mental workout and it's the only path to moving on to more advanced math. And....believe it or not algebra ***IS*** much easier to learn than many of us think!

Caterpillar Connections Unit Overview

<u>Day 1: Determining the Relations</u>

Students explore the relationship between the shapes of the pattern blocks. See attached worksheet.

<u>Day 2: Introduction to Caterpillar Connections</u>

Students are introduced to a hypothetical caterpillar that grows one unit each day. Through the use of pattern blocks and class discussion they will develop a formula to coincide.

Then, the students are presented with a problem. Through a change in color, the number of blocks per unit will change from one to two. A new formula will be devised.

Day 3: Research Lesson-Today's Lesson

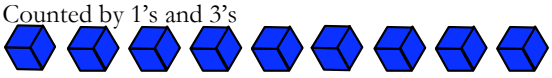
Day 4: Introduction to variables

Students are exposed to further changing variables within the caterpillar scenario. Students will practice forming equations in other situations.

Examples: D = # of days B = # of blocks

D x B = total

Learning Process (or Plan of Lesson)

Steps, Learning Activities Teacher's Questions and Expected Student Reactions	Teacher's Support	Points of Evaluation
1. Introduction Review journal entries from previous day's lesson	Encourage students to refer to notes from previous day's lesson	Are students able to refer to notes from journals?
2. Posing Problem Our fantasy caterpillar has changed color once again. Something happens on Day 9. He now turns blue! How many blue do we need to make a caterpillar on Day 9? **Are students able to explain the formula?** # of Days **x** # of unit blocks = total	Divide students into pairs to support each other. Confirm predictions using formula.	Are students able to predict what day nine will look like? Are students able to use the formula to predict outcome?
3. Solving Problem Anticipated Student solutions Counted by 1's and 3's  3+3+3+3+3+3+3+3+3=27 9x3=27	Does this fit to the formula?	Are students able to solve the problem? Do students know what each number represents in the equation?
4. Extending the Problem It is Day 11. I have a caterpillar that is made of 66 blocks. Work with your partner tto find out what color could he possibly be?	Ask students to explain their solutions. Students are expected to use their previous knowledge as an easy way to find. Students will work in groups with hexagon shapes to solve problem. Teacher will walk among tables to see methods chosen. Encourage students to talk freely about their ideas for finding the number of seats with their partners. Students will record their thinking in their journal books. Teacher encourages students to develop different ways to solve problem.	Are students able to use the formula? Do all the groups use the same strategy to find the color of the caterpillar? Do all the groups understand the different solutions?

5. Solving Problem Anticipated Student solutions  11x6=66 6+6+6+6+6+6+6+6+6+6+6=66 66÷11=6 count up from blue "add up"	Students will go to board to write their strategies used to solve problem.	Does the class agree on an easy method to find the color of the caterpillar?
6. Comparing and Discussing Students will be given the time to work with partners to find color of Day 11 caterpillar. Ask students to explain and record explanations in journal books. Students will be called to the board to explain their strategies	Ask students to explain their strategies and record their strategies on the classroom board in order to help other students understand the solution to the problem. The students called to the board will represent the different strategies students used. Make sure students know what each number represents in their solution.	
7. Summing up Using the writing on the board, review what students learned through the lesson. Ask students to write a journal entry about what they learned through this lesson.		

Evaluation:

There are three important goals of the lesson. The first goal is to deepen students' understanding of the concept of multiplicative reasoning. Students will use formulas regardless of color and number of days to find the total number of pattern blocks for any given length and shape.

The second goal is to have students to verbally express why they used a particular solution method. While looking for and applying relationships between varying quantities to make predictions, students will express their thinking on how they solved a problem and what strategies they used to solve the problem.

The third goal of the lesson was to have students to work collaboratively and learn from their peers. Students will discuss solution methods, ask questions of each other, and consider other students' perspectives when solving math problems.