

Production of Algebraic Expressions

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Third Grade Lessons

1. **Candy Boxes** - This class centers on the possible amounts of candies two children, John and Maria, have. They each have the same, unspecified number of candies inside their own candy box. John has, in addition, one extra candy and Maria has three extra candies. What are the possible total candies they might have?
2. **Comparison Problems & Tables** - This class will be used to review concepts and representations as applied to the solution of verbal comparison problems and to work on function tables.
3. **Dinner Tables II** - Students work with a function relating the number of tables (in a straight line) to the number of available seats. One table seats 4, two tables seat 6, three tables seat 8...
4. **Functions - Earning Money** - The students will create tables and equations from given stories. The functions are additive and multiplicative.
5. **Functions II** - The students will use three functions that are represented as a sequence of patterns and create a sequence of hops on the number line, a data table, and an algebraic expression to express the functions.
6. **Guess my Rule - Multiplicative Tables** - Two children create secret rules for transforming input numbers. The teacher uses a doubling or tripling rule.
7. **Guess my Rule - Tables** - Two children create secret rules for transforming input numbers. The teacher uses a doubling rule.
8. **Multiple Number Lines** - Students continue to learn that two partial changes that start at different points on the number line are equivalent. At the end, they will work with notation for variables ($N + 5 - 3$ or $N + 2$).
9. **N-Number Line I** - Students work with the table they built in the previous class for multiple number lines, focusing on the notation for variables ($N + 5 - 3$ or $N + 2$).
10. **N-Number Line II** - Students use the N-Number line to make generalizations about an unknown amount of money in a piggy bank.
11. **Number Line - Locations** - Students place themselves at points on the number line. Main contexts: stairs, age, money, temperature, and pure number.
12. **Number Line Shortcuts** - The students will use a number line to see how two addends or subtrahends are equivalent to one single change once combined.
13. **Piggy Banks** - The whole lesson revolves around a multipart story problem involving changes in two quantities over several days of a week. The initial quantities are equal yet unknown. Then transformations are applied to the quantities. Students are asked to compare the quantities throughout the week even though only their relative relationship can be determined.
14. **Three Heights** - In this class we will explore: (a) How the children deal with comparisons, (b) How they draw inferences from comparisons, and (c) How they represent comparisons between three unknown amounts.

Fourth Grade Lessons

1. **Evaluation Problem** - Students will be given a problem that asks about the amount of money each person has, based on the amount in a piggy bank. They will be given one graph and asked to draw the second graph.
2. **Multiplicative Candy Boxes I** - This class centers on the possible amounts of candies two children, Juan and Marcia, have. Juan has a box of candy and Marcia has twice as much candy. What are the possible amounts of candies they might have?
3. **Multiplicative Candy Boxes II** - This class is a continuation of the Multiplicative Candy Boxes I lesson. It centers on the possible amounts of candies two children, Juan and Marcia, have. Juan has a box of candy and Marcia has twice as much candy. What are the possible amounts of candies they might have?
4. **The Better Paying Job I** - Children work on a problem about rate of pay per hour of work. They compare ratios (dollars earned per hour of work) and discuss and plot points in a Cartesian plane.
5. **The Better Paying Job II** - Children work on a problem about rate of pay per hour of work. They compare ratios (dollars earned per hour of work) and discuss and plot points in a Cartesian plane.
6. **Three Heights Review** - In this class we will explore: (a) How children deal with comparisons, (b) How they draw inferences from comparisons, and (c) How they represent comparisons between three unknown amounts.
7. **Wallet Problem I** - Students compare the amounts of money two students have. The amounts are described relationally but not through precise dollar amounts.
8. **Wallet Problem II** - Students will be given a wallet problem. They will be asked to compare the amounts of money two students have. The amounts are described relationally but not through precise dollar amounts.
9. **Wallet Problem III** - Students will continue working with the wallet problem. They will be shown a graph for Mike's amounts and asked to (a) determine whether it represents Robin's or Mike's money and (b) to predict where the line for Mike would fall. Later they will plot Mike's amounts and will discuss why the lines cross.

Fifth Grade Lessons

1. **Arcade** - Students are told a story about two children, each of whom has a certain amount of money, but only one of whom has an amount known to us. After a series of events they happen to end up with the same amount of money.
2. **Enacting and Solving Equations** - Students enact and discuss a situation where two children have amounts of candies. Some of the candies are visible, others are inside opaque tubes or boxes. After considering multiple possibilities they are told that the children have the same amount of candies. The situation corresponds to the equation $3x + y + 6 = x + y + 20$, where x is the amount of candies per tube and y is the amount of candies per box. Students will be asked to discuss and to represent the situation, to solve the equation that corresponds to the situation, and to solve other written equations with similar structure.
3. **Equations and Graphs** - Students will further compare two linear functions in the context of evaluating two plans for shoveling snow. One plan has two parts: a basic charge plus a charge based on the number of square meters cleared. The other plan has no basic charge; it only charges according to the number of square meters cleared. However the per-meter charge is higher than in the other plan. Students are asked to determine the circumstances in which the bill from each plan would be the same. They then examine the graph of the two functions and discuss how equations and inequalities relate to the graph.
4. **Fifth Grade Assessment I** - This assessment will focus on writing equations to solve verbal problems and on solving equations using syntactic rules. It is intended as a diagnostic tool to assist teachers in planning future activities.
5. **Fifth Grade Assessment I Review** - This lesson will focus on reviewing the recent in-class assessment, on writing equations for word problems, and on solving equations.

6. **Fifth Grade Assessment II** - This assessment will focus on writing equations to solve verbal problems and on solving equations using the syntactic rules of algebra.
7. **Fifth Grade Assessment III** - This assessment will focus on writing equations to solve verbal problems and on solving equations using the syntactic rules of algebra.
8. **Phone Plans** - Students will compare two linear functions in the context of evaluating phone plans. One plan has two parts: a basic charge plus a charge based upon the number of minutes used. The other plan has no basic charge; it only charges according to the minutes used. However the per-minute charge is higher than in the other plan. Students are asked to determine the circumstances in which the monthly bill from each plan would be the same. They then examine the graph of the two functions and discuss how equations and inequalities relate to the graph.
9. **Review on Graphs and Equations** - In this lesson, the students will solve individually or in small groups the set of problems. For each problem, the teacher will lead a discussion based on the students' work (the teacher should identify strong and weak points in the students' work). The class is organized around four main problems. Within each problem students will answer different questions.
10. **Solving Equations with One Variable** - Students work on a story about two children who each have a certain amount of money. The amount of one of the children is known but the other is not. After a sequence of transformations they end with the same amount of money. Students will be led to solve for the starting value by relating the equation to the events in the story. After that, they will be asked to solve another similar problem.
11. **Train Crash** - Students will compare two linear functions represented in a graph. They reason about the problem using (a) the word problem and two diagrams; (b) a graph of position vs. time; (c) a table of values (d) making expressions for each position function; and (e) solving the equation algebraically.
12. **Wallet Review Problem** - This activity is a review of the Wallet Problem done in fourth grade. It is intended to introduce new students to some of the concepts we have covered and to refresh the memories of our old students. Students compare the amounts of money two students have. The amounts are described relationally but not through specific dollar amounts.