

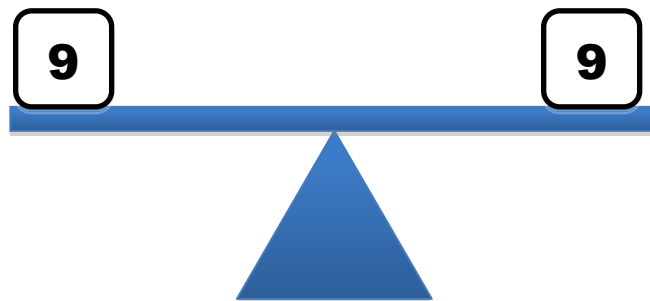
Using Sports to Incorporate Algebraic Expressions

Emily Sansale

Introduction

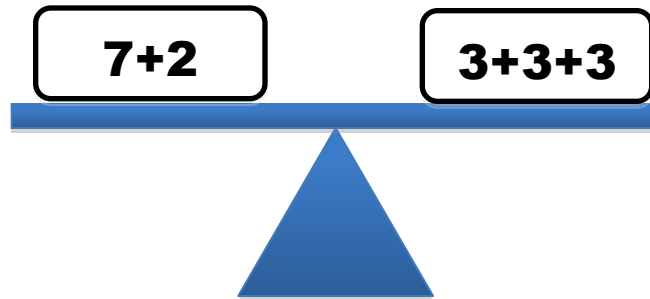
Algebraic expression is not a common mathematical strategy that you use in your daily life. You hear it from time to time while you are going through school and once you get out, you never hear of it again. This is the reason why the concept is hard to grasp because it is not used in every common day situation. You have heard the saying “Don’t use it, you lose it”. Well, that is the case with algebraic expressions. However, like how finding a dusty toy from the back of the closet can lead to days of fun, we can use many mathematical ideas and may, even without our awareness, already be using aspects of them. I want everyone young and old to use algebraic expressions during their daily life to help them understand and estimate mathematical situations. Some students are also not that excited about math. I am hoping that this lesson will change that around and let the students look at math in a different perspective though the lens of pop culture.

When teaching elementary students algebraic expression, it is hard to create real life situations to go along with the problems. When teaching the algebraic expression, a teacher can refer to weighted scale. The scale will be balanced if both sides contain the same amount. This is easiest to see if we simply give numbers like below:



Algebraic expression helps us uncover the various ways a value can be attained through arithmetic. For instance, if I have 30 cents of change in my pocket, then a variety of possibilities exist for what coins I have. For example, I could have 6 nickels, 3 dimes, or a quarter and a nickel, to name a few possibilities. If we include pennies, many more combinations arise. If I had 3 dimes in one pocket and 6 nickels in the other, then both pockets have the same amount of change. Returning to the scale, the scale is balanced if

the equations on each side result in the same amount. This can be seen in the equation below:



This demonstrates that if two sides of an equation represent the same value, they are indeed equal even though different combinations of numbers may be used on each side of the equation. Once again, when are you going to use this technique? This unit will be able to engage students by combining something they like with algebraic expression. In particular, we look at sports. Students will select a sports team's winning score. They will explore different combinations of numbers that could have created the final score of the game. I plan to use this unit for the NFL. For example, $3+3+3$ and $7+2$ both equal 9. Imagine however, that the first half of a game ends with a 9-9 tie. One team reached a score of 9 from three field goals and the other team scored a touchdown and a safety. These are very different combinations of events in the game. We'll discuss this more momentarily and review how points are scored in football.

The students that I teach come from an urban setting. Their parent(s) might work. Some students care for their younger siblings, leaving them little time for themselves. Some of these households do not push education as a priority. Economic realities can create a desire for my students to work to help pay the bills or help even more with family care. Many of my student's households include grandparents, uncles and aunts, and even cousins. Creating a space to concentrate on homework, let alone finding time can be challenging. That said, I feel the support of many parents who want their child to succeed in school. I appreciate the students that are striving to be the best that they can and are looking to go far in their education. Many of them are excited to be at school. The group that I have this year is special to me because many of them missed getting into the Talent Development program but because I became AIG certified this summer, I am able to extend the learning just like the TD classes do but also be able to fall back on "normal" classroom activities as well. This year's group of mathematicians keeps me on my toes with bright questions. They are always trying to find new ways to figure out a problem. It is this context, with its inspiring and challenging components, that inspired this unit on algebraic expressions. I look forward to seeing these ideas engage the students and lead to fun conversations in my classroom.

Rationale

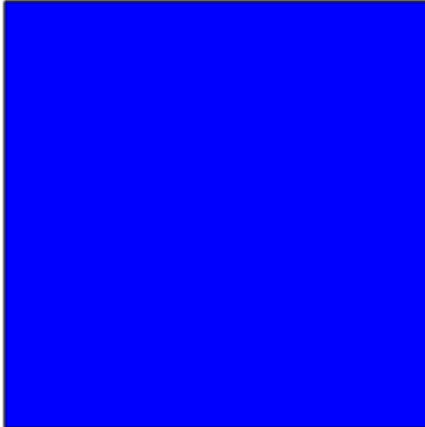
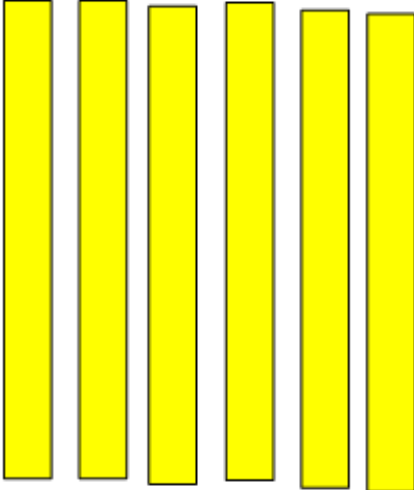
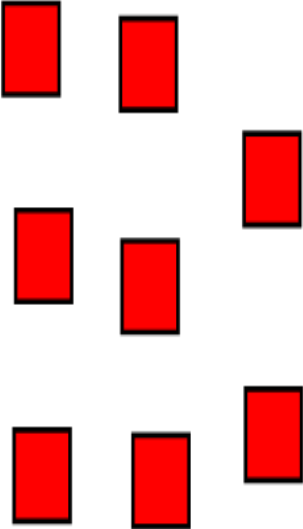
This unit is important for me to teach because I want the students to use more of the math we explore together. It doesn't have to stop after taking the test or when we move on to other topics. I believe that it is all too easy for us teachers to become robotic in our instruction and just teach to the end of year tests because of the level of importance given to them. Teaching can be much more. Teaching should be something that is fun and engaging that the students enjoy and use in the future. Algebraic expressions I believe can help a student's estimation by trial and error with setting up the equation and discovering what combinations equate to the desired answer. I also like algebraic expressions because one solution can have a large number of possible combinations that equal the solution. This requires giving the students time to manipulate numbers in a fun and creative way.

I think this unit is also important to teach because it shows the students that they can incorporate math into something they enjoy such as sports. Yes, it is fun to watch someone get a touchdown but it is also fun to manipulate the numbers and find different combinations that give the same final score. It gives the students a context to play with their favorite teams while also using the algebraic expression. The students will be so engaged that they will forget that they are doing math!

Content Background

To teach this lesson, the students first need to understand whole numbers and place value. While this should be taught in the beginning of the year it would also be helpful to give a refresher. For example, if given the number of 168, the students need to know and understand that there is 1 one hundred, 6 tens, and 8 ones. This is important since, as we saw previously, a number such as 9 can be broken into $3+3+3$ and $7+2$. Similarly, we saw that 30 cents could be attained by 3 dimes or 6 nickels. Before finding these types of combinations, a student needs to be comfortable with a number like 35 having 3 tens and 5 ones. Again, coins can be helpful and familiar. When the numbers reach sizes like 168, a place value chart can be very helpful. I also like to use review games to engage the students. Later in this unit, I will discuss a review game that can also teach the game of football for those students less familiar with the game and its scoring, which is also important to this unit.

Again, before a student tackles how a football team might of scored 15 points, the student needs to be able to determine that 321 contains 3 one hundreds, 2 tens and 1 one. In the following figure we see a way of visually representing these. A teacher may decide to use manipulatives for such activities if they are available.

Hundreds	Tens	Ones
		

The students also need to know about inverses. An inverse, in a sense, undoes another operation and as such can be considered an opposite. Take multiplication, the students need to know that the inverse of multiplication is division and vice versa. They have to be comfortable doing both ways for all orders of operations. The students also need to understand that the equal sign means that both sides have equal amounts. Many students believe the equal sign means that it is the answer. That is the case but the breakdown of it is that each side has equal numerical amounts. This topic might need to be taught before going on to algebraic expressions because the students need to know that equal amounts must occur on each side. One way to study this is to assign amounts to different shapes. For example, if a triangle is worth 5, a square 6 and a circle 2. Then, if we have two triangles and 1 circle on one side of the scale, what shapes can we place on the other side to balance the scale?

$$\triangle = 5 \quad \square = 6 \quad \bigcirc = 2$$

$$\triangle \triangle = \bigcirc \bigcirc \bigcirc \bigcirc \bigcirc$$



The students need to also understand that a letter (symbol) stands for a number. In place of a number, there is a letter in its place. The letter creates a puzzle. What value could we write in place of the letter for the equation to be equal on both sides? The variable simply stands in the place of a number until the correct number can be computed and inserted back into its place.

$$\begin{array}{l} \text{Variable} \\ \swarrow \\ 2 + y = 7 \\ y = 5 \end{array}$$

$$\begin{array}{l} \text{Variable} \\ \swarrow \\ y + 8 = 14 \\ y = 6 \end{array}$$

The students also need to understand the role of constants, which are numbers or symbols that do not change value. They will always be the same but will help you get an answer to the problem. Be careful in this unit as to the role of the letter. Earlier, a y in one equation might equal 5 and in another 6. However, in our work, T will stand for the points gained by a touchdown and have a constant value.

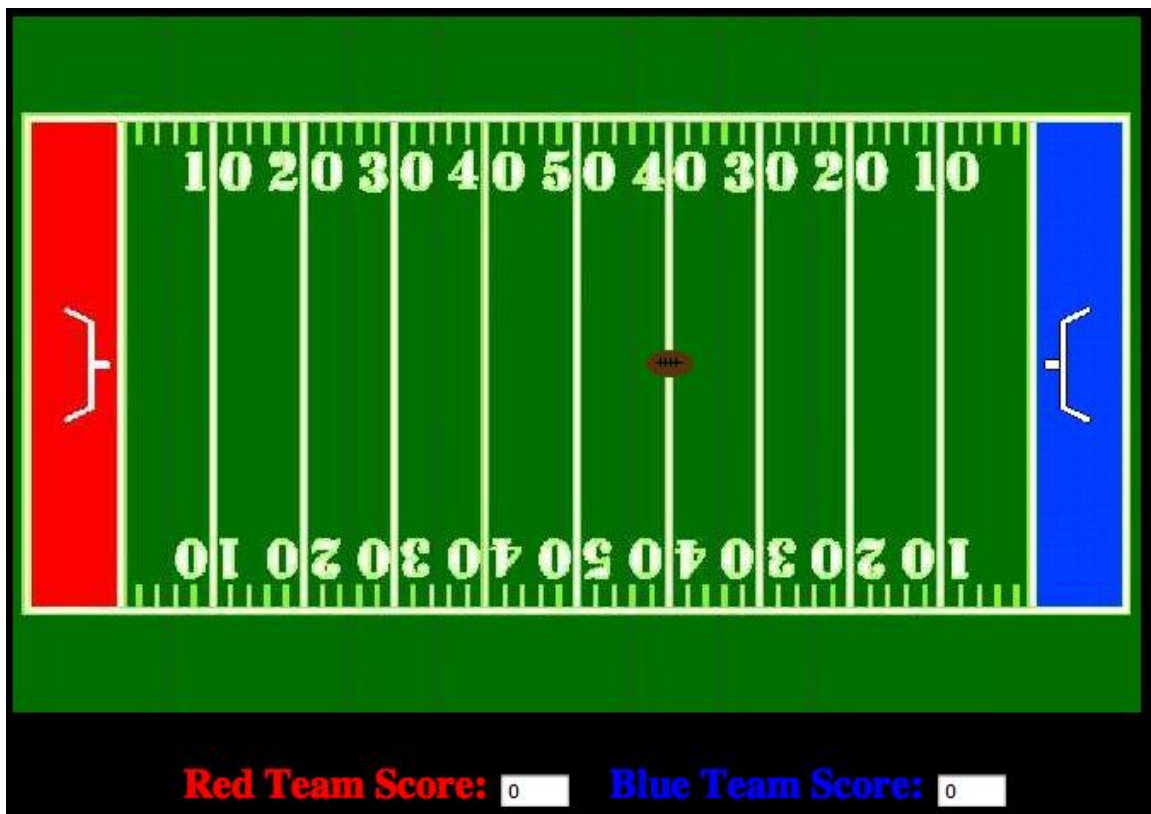
Constant Variable

$2 T + 3 F + 4 S = \text{your answer}$

Finally, I will review (and for some teach) the game of football. If you are a football fan, it can be tempting to think everyone knows the game of football. Do they really? I thought I was good with most of the understanding but I was proved wrong as I explored this unit. There are four main parts of football that play a fundamental role in this unit. There are other aspects of the game and we will not discuss those, narrowing our view only to four ways teams score the points. A touchdown is when a player from one team catches the ball and runs to the opposite team's end zone. When this occurs it is a touchdown and it is worth 6 points. A field goal is when the kicker from the team kicks the ball between the uprights of the field goal. If they are able to get the field goal after the touchdown that is called a point after touchdown which is worth 1 point. When the team has run out of downs and are close to the end zone, they are able to attempt a field goal which is worth 3 points. A two point conversion occurs after a touchdown when the team lines up and runs or throws the ball again into the end zone; this occurs in place of attempting to kick a point after the touchdown. Finally, a team can score a safety, which occurs when a player from a team gets tackled in his own team's end zone.

To practice the game of football we would play Academic Football on the Smartboard. To play Academic Football, the students first need to split into two groups. The referee will ask the offense what level of difficulty they would like: 10 yards, 20 yards, 30 yards or 40 yards. The referee will then pick the selected difficulty. Then if the offense answers correctly, the ball will move the yardage that they chose. If the offense answers wrong, a "bad pass" will be called and the question then goes to the defense. There will be a small "media" break before the question will be asked. If the defense answers correctly, they have the opportunity to "sack the quarterback" for a 10 yard question or to possibly intercept a 10, 20, 30, or 40 yard pass when the pass play was selected. Sacking a quarterback in the end zone is a safety worth 2 points which the students should know. If the defense does not answer correctly, the ball is dropped and the play continues. After each touchdown, the ball always starts on the 20 yard line. Just like the real game of football, the offensive team has 4 downs to get 10 more yards. In Academic Football, there are no field goals. On the fourth down, the offensive team can select to punt the ball which would then start the other team on their 20 yard line. If there are any questions after we play, I would address them according.

Such a game can be played on the whiteboard. If you have the ability to project Internet webpages, you may wish to use Academic Football (found at <http://www.davidson.edu/math/chartier/Pff/Football/football.html>), designed by Tim Chartier and adapted from Positive Classroom Disciplines by Jo Lynee Talbott Jones and Fredric H. Jones. The online version contains a pop-up window, seen below, with an interactive field that also keeps score. In the picture below, the ball is on the 40-yard line with both teams currently tied in a scoreless game. A user clicks the screen to progress the ball. Such uses of technology can capture students' attention when they are easy to integrate into class.



Strategies

This lesson is going to be taught in three days in which each period lasts, one hour. The first day I will go over the vocabulary such as variable, constant, algebraic expression, inverse of an operation and operations. I will show examples on the board starting out simple. From my years of experience, addition and subtraction are the best place to begin. The students feel really comfortable with doing adding a subtraction. Plus this is also a great review because we still make silly mistakes when we add and subtract because the students tend to rush. You as the teacher really need to make it a point to teach the students that they need to stay focused because when they start doing

multiplication and division that becomes more complicated for some students. I will first demonstrate and discuss that you want to get the variable by itself. I will have the students look at the operation that they are working with and have them tell me what the inverse is. Usually they pick up on this task very quickly. If the operation is to add, the students will/should say subtract. I will let the students know that what we do on one side of the equal sign we do on the other. Once we subtract both sides of the equal sign, the students should see that we have a variable and a number left over. I will explain to the students that the number that is left over is the answer to the variable for just this problem.

$$y + 9 = 14$$

$$- 9 = -9$$

$$y = 5$$

$$x - 6 = 24$$

$$+ 6 = +6$$

$$x = 30$$

I will remind them the variables can change in their value from problem to problem. I emphasize the need to check the answer and verify the math. To do this, the variable is replaced with the number it equals. When you perform the computation, both sides of the equation shown equal.

$$5 + 9 = 14$$

$$30 - 6 = 24$$

I will do the same process for division and multiplication. Multiplication and division algebraic expressions are a little bit trickier. Showing how to get the variable alone takes careful explanation. You have to remind the students that multiplication can be shown in three different ways. The ways are 1) with an x, 2) having the number and variable right next to each other, such as 5c and 3) having the number and variable separated by a dot in the middle of them, such as 9*w. Every year the students have more of a hard time understanding algebraic expressions with division than multiplication. To me the hardest to teach and to show is division.

$$\begin{array}{r}
 5 \times q = 45 \\
 \div 5 \quad = \div 5 \\
 q = 9
 \end{array}$$

$$\text{Check: } 5 \times 9 = 45$$

The students will have homework to practice this skill to get ready for the next day of class.

The second day we will play Academic Football on the Smartboard to introduce the game of football to students that might not know. I think this will be great introduction to what we will be working on and tying together both football and algebraic expression in the next math lesson.

The third day I will revisit the idea of algebraic expressions with a quick review of some problems. The students should be able to get the correct answers. If there are still some questions, I will address them accordingly. At this point, I will introduce the sports teams. Let's take the NFL. The students for the most part are fans of certain teams. We like to tease each other because one team loses or another other team wins. We do it all in good fun! But today I am going to have the students pick a team and look at one of the final scores that have been played in the previous few weeks. Before this lesson gets really underway, I will review with the students the ways that the teams can acquire points. The students need to understand some football terms and points given to those terms. A touchdown gives the team 7 points. A safety gives the team 2 points. A field goal gives the team 3 points but if it is after a touchdown it is only worth 1 point. A two point conversion is worth 2 points for a team as well. The students should have these written down so they can reference them while creating their algebraic expression.

Once the students pick a team and the final score for that week, the students will then create a new algebraic expression. So for example, we will use the Chicago Bears. Each student will have all of the final scores for the 2011-2012 season. Following is a list of the scores for the Chicago Bears and their opponents up to week 12 of the 2011-2012 NFL season.



Chicago Bears	Opposing Team and their scores
30	Atlanta 12
13	New Orleans 30
17	Green Bay 27
34	Carolina 29
13	Detroit 24
39	Minnesota 10
24	Tampa Bay 18
30	Philadelphia 24

37	Detroit 13
31	San Diego 20
20	Oakland 25

The students will pick a final score from their team that they chose. I will pick the score from week three where the Bears scored 17 points. This is going to represent the answer to the equation. What the students are going to have to do is figure out what combinations of touchdowns, point after touchdown, field goal, safety and point conversion could create this score. You need to remind the students that the variable is going to stay the same every time but the coefficient before that variable is going to change for these algebraic equations.

Touchdown = 6

T will stand for touchdown

Point after Touchdown = 1

P will stand for point after touchdown

Safety = 2

S will stand for safety

2 point Conversion = 2

C will stand for 2 point conversion

Field Goal = 3

F will stand for field goal

There are many possibilities for creating these algebraic expressions. Knowing this, I chose the score of 17 rather than the score of 39. Here are 6 scenarios that could have produced the winning score of 17 for the Chicago Bears.

$$2T + 2P + 1F = 17$$

$$1T + 3S + 2C + 1P = 17$$

$$2(6) + 2(1) + 1(3) = 17$$

$$1(6) + 3(2) + 2(2) + 1(1) = 17$$

$$12 + 2 + 3 = 17$$

$$6 + 6 + 4 + 1 = 17$$

$$2T + 1P + 1S + 1C = 17$$

$$2T + 1P = 2C = 17$$

$$2(6) + 1(1) + 1(2) + 1(2) = 17$$

$$2(6) + 1(1) + 2(2) = 17$$

$$12 + 1 + 2 + 2 = 17$$

$$12 + 1 + 4 = 17$$

$$2T + 1P + 2S = 17$$

$$2(6) + 1(1) + 2(2) = 17$$

$$12 + 1 + 4 = 17$$

$$5F + 1S = 17$$

$$5(3) + 1(2) = 17$$

$$15 + 2 = 17$$

I found 6 possibilities. There are definitely more. Ask your students to find more! I want to challenge my students to think outside of the box regarding the scoring combinations. The six different ways I computed could have occurred in the Bears loss to Green Bay. Did the Bears lose the game by these combinations? Probably not. In fact, if I had turned on a game and saw a score of 17, I wouldn't know exactly what had happened. I want my students to understand that there can be many different combinations to score for a team winning or losing a game.

At this point, my students hopefully would have firmly grasped the concept of how algebraic expressions can help them create different scenarios on how their favorite team was able to win or lose a game. I want to push my students a little farther in their thinking. This part of the lesson is just about having fun. Every football score is created from the same scoring possibilities. We'll reach back to a game in the early 1900's and think out of the box with the 1916 match-up of Cumberland and Georgia Tech. As you can see in the scoreboard that follows, Georgia Tech won by a landslide. We can first look at this game like we did with the Chicago Bears game and assume no safeties were scored. Then, Georgia Tech could have been able to win the game 80 different ways over Cumberland. But if includes safeties, Georgia Tech could have made 111 safeties which more or less is not even possible, or could it be? If Georgia Tech's win could have resulted from any possible combination of scores, realistic or not, then Georgia Tech could have won in 8,162 different ways! Now I am not going to ask the students to find all the different combinations, but I do want them to figure out a few. I want my students to become creative and inventive.



To show this, I am going to take the Bears score from week seven in which the Chicago Bears scored 24 against Tampa Bay to win the game. (Yea for me as a Bears fans!!!). Let's use our same scoring combinations and create some crazy ways that the Bears might have won.

$$4T = 24$$

$$6S + 6C = 24$$

$$12S = 24$$

$$4(6) = 24$$

$$6(2) + 6(2) = 24$$

$$12(2) = 24$$

$$24 = 24$$

$$12 + 12 = 24$$

$$24 = 24$$

$$12C = 24$$

$$8F = 24$$

$$3S + 3P + 3C + 3F = 24$$

$$12(2) = 24$$

$$8(3) = 24$$

$$3(2) + 3(1) + 3(2) + 3(3) = 24$$

$$24 = 24$$

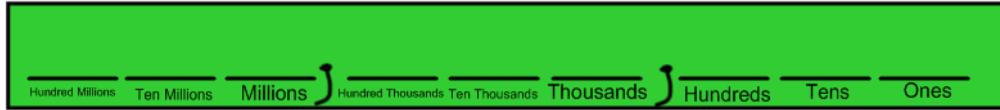
$$24 = 24$$

$$6 + 3 + 6 + 9 = 24$$

Now some of these I guess could be feasible but the students need to know that safeties and 2 point conversions do not happen that often. So, to have 12 safeties in a game, probably, if not certainly, would never happen. For fun, the students can create some improbable scenarios and then explain to the class how it might have happened. For example, how might a team have gotten 12 safeties? Did one of the players get hit so hard he simply kept running, every single time he got the ball, the wrong way? Maybe one day we could see a game with one of these seemingly wild combinations!

Activities

A great review game other than using a place value chart is having the students practice place value on a sentence strip. Have the students drawn nine lines at the bottom of one side of the sentence strip and label them with the correct place value. Then have the students get in partners. Each group will have either digit cards or you can use play cards. One partner will put cards on the sentence strip in the order they were pulled from the deck. The other partner has to say the number with the correct place value. You can give points to the student who says the number correctly. If they do not say it correctly, the point goes the student that flipped the card. They can then trade back and forth.



The first activity the students will do involves practicing with algebraic expressions. This will be done both in class and as homework because I want the students to be comfortable with the idea of being able to take away numbers from both sides of the equal sign to get the variable alone. This, in turn, indicates to the students what the variable equals. While doing this activity in class, the students will be able to explain their answer and why they believe they did it correctly. The students then will get into groups and create their own problems. This will demonstrate the students' understanding of algebraic expressions as they are able to figure them out correctly. Also for their homework, they will be asked to create four algebraic expressions using all operations and create a story problem that goes along with the equations. These equations and story problems will be shared at the beginning of the class and also can be used for morning work when the students are coming into the classroom.

$$X + 9 = 24$$

$$49 / N = 7$$

$$8 * Q = 64$$

$$25 + J = 62$$

$$G - 9 = 57$$

$$5 * U = 25$$

$$K - 9 = 26$$

$$81 / V = 9$$

For the next activity, students will play Academic Football in the classroom to get ready for the next day's lesson. This was explained earlier in the unit. After playing Academic Football, the students should have a good grasp of football and its scoring. The students will also practice again for homework solving algebraic expressions. I want the students to be comfortable with understanding the concepts and rules. I will also have the students pick their favorite football team so I can have the scores ready to go for the next day's lesson. Again, the web address for Academic Football is

<http://www.davidson.edu/math/chartier/Pff/Football/football.html>

$$Q - 7 = 49$$

$$5 * J = 35$$

$$36 / F = 6$$

$$H + 18 = 35$$

$$72 / Y = 9$$

$$O - 25 = 125$$

$$K + 86 = 201$$

$$9 * D = 36$$

The last day of the lesson involves students exploring algebraic expressions with their favorite football team. Again, a score will come from one attained during the 2011-2012 season. We will then start the activity by using the key that I create of the different ways their team would be able to acquire the points that they did during the game. I would have the students explain in written form one of the ways they computed and how their team could have received their final scores. This to me would be a great way for the students to show that they were able to understand the concept I was trying to teach with algebraic expression.

An activity that I would have as a center for RTI that we do at our school is to let the students be creative in finding surprising ways that their team could have scored the points that they did. They once again would have to write and explain why they chose the point value they did. I also would like the students to have fun and create a headline/newspaper report on their team's surprising way of scoring. If they have the time they could create a picture that went along with the article.

Implementing District Standards

Using Sports to Incorporate Algebraic Expressions

Emily Sansale

This unit covers two different sections of North Carolina Standard Course of Study. The first standard that is covered is Number and Operations in Base Ten 5.NBT. The students need to know place value to understand the rest of the unit. The Standard Course of Study has the bar set for the students to understand the place value system. Place value is the very bottom of mathematics. If the students do not understand place value, not only with this unit but with other math tasks, the students will struggle to grasp the concept that is being taught. This unit covers the first objective which is being able to recognize a multi-digit number and understand that the number to the left is 10 times the number to the right. The objective is taught for the students to review this concept. This objective can also be used when the students start to practice algebraic expression before they get to the football unit.

The next North Carolina Standard Course of Study that this unit is able to meet is Operations and Algebraic Thinking 5.OA. This standard focuses on how to write and interpret numerical expression. After the students review place value, the student will then move into understanding the parts that create an algebraic expression. The students will use parentheses to evaluate expressions when they begin to start using algebraic expressions when create and finding new ways their sports team did and could win a game.

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This website is to show and help the reader understand the Academic Football game to get the students ready for the next lesson.

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