**Learning Progression:**

Algebra 1: Expressions, Equations, and Applications by Paul A. Foerster;

9th grade

February 2, 2014

**Introduction**

The following learning progression is based on meeting the cluster on Algebra under ‘Solving Equations and Inequalities in one Variable’ standard under the Reasoning with Equations and Inequalities math domain. This cluster has been taken from the Common Core State Standards for Mathematics. The full standard cluster is shown on the right. The book where I got activities or homework problems from is called Algebra I: Expressions, Equations, and Applications by Paul A. Foerster. The activities are focused on assuming this is a 9th grade class; however, this may vary.

CCSS.Math.Content.HSA-REI.B.3: Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

CCSS.Math.Content.HSA-REI.B.4: Solve quadratic equations in one variable.

CCSS.Math.Content.HSA-REI.B.4a: Use the method of completing the square to transform any quadratic equation in *x* into an equation of the form (*x-p*)2=*q* that has the same solutions. Derive the quadratic formula from this form.

CCSS.Math.Content.HSA-REI.B.4b: Solve quadratic equations by inspection (e.g., for *x*2=49), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as *a*±*bi* for real numbers *a* and *b*.

**CCSS.Math.Content.HSA-REI.B.3**

The math standard that I will be discussing is ‘solving linear equations and inequalities in one variable, including equations with coefficients represented by letters’.

The following are ideas and activities that students could use for successful achievement of the standard.

For this lesson it is important for students to understand the following vocabulary:

* Equations
* Inequalities
* Variable
* Coefficients

Using this terminology, we need to ensure that students are able to solve linear equations and inequalities in one variable, such as

CCSS.Math.Content.HSA-REI.B.3: Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

4= *c* – 1.

To ensure that students become fluent in this material, beginning with a short lesson is necessary. One way to help students understand this process better is by thinking of it as adding equal weights to both sides of a balance. If students add weight to only one side, it will no longer balance. A few oral examples can be given such as those found in the book on page 29. Examples include:

*x*+4 = 13 and 1/3*x* = 9

such as those shown on the right. A great activity for students to demonstrate their conceptual understanding is by having students do the ‘Oral Practice’ in the book on page 29. Students can both, do it in groups or as a class and have them reply as a whole what the first step to solving equations should be as stated in the book. Oral practice is also a proper accommodation for students with special needs or English language learners (ELL) since they are also listening to the vocabulary being used.

CCSS.Math.Content.HSA-REI.B.3: Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

Another great activity for students for procedural understanding is to have them apply their knowledge, which will also help them gain practice, by going on to the IXL website for some practice problems.

<http://www.ixl.com/math/algebra-1> Students will practice under ‘solving equations’ J.3 and then J.4. This is an interactive website that teachers can use as formative assessment. Students go on, type in the answer, and their score and time elapsed will be recorded on the right-hand side. Teachers can walk around and peek over at each student’s computer screen and see how they are doing. For practice problems at home, I would give students numbers 1-30 on page 29 in the book to apply some more of their knowledge.



There should also be a short lesson on solving inequalities. Oral practice problems are also encouraged and found on page 577 in the book. Students can also apply their knowledge using the same website as before, IXL <http://www.ixl.com/math/algebra-1> Students will apply their knowledge and practice problems under T.2. While students are working on the practice problems, the teacher could call students one by one, give them a problem, and ask them to explain their reasoning in order to assess how each student is doing. At the end, students could get a worksheet as homework to apply their knowledge and gain more practice outside of school.

CCSS.Math.Content.HSA-REI.B.4

* CCSS.Math.Content.HSA-REI.B.4a

The following are ideas and activities for the next standard in the cluster:

For this lesson, it is important that students understand the following vocabulary



* Completing the square
* Quadratic equation

Students need to have previous understanding of and know how to solve equations with squares. Using this terminology, we need to ensure that students are able to solve quadratic equations in one variable using the method of completing the square to transform any quadratic equation into an equation of the form (*x - p*)2 = *q*.

First, there needs to be a lesson on solving quadratic equations by completing the square. This standard aligns to section 6.7 in the book on page 237. A few examples such as

(*x* - 5)2 = 18

should be given to students to remind them how to solve equations with squares. This will allow for students to remember previous material and make connections to the new material being introduced. Then, the teacher could proceed to the lesson. There is an ‘Oral Practice’ activity in the book on page 239 that the teacher can use with students. Oral practice is also a proper accommodation for students with special needs or English language learners (ELL) since they are also listening to the vocabulary being used. These oral activities help all students obtain a better understanding of the vocabulary by hearing it repeatedly. An example is shown on the top right corner.

CCSS.Math.Content.HSA-REI.B.4: Solve quadratic equations in one variable.

CCSS.Math.Content.HSA-REI.B.4a: Use the method of completing the square to transform any quadratic equation in *x* into an equation of the form (*x-p*)2=*q* that has the same solutions. Derive the quadratic formula from this form.

Students can practice the ‘oral problems’ first in groups to help each other learn the vocabulary and material and then as a class with the teacher as their guide. As for formative assessment, the teacher can give students practice problems 1-20 from the book on page 239. The teacher can walk around and assess how students are doing. The rest of the problems that students do not finish can be given as homework problems for practice outside of school.

CCSS.Math.Content.HSA-REI.B.4

* CCSS.Math.Content.HSA-REI.B.4b

This is the last standard under the cluster.

CCSS.Math.Content.HSA-REI.B.4: Solve quadratic equations in one variable.

CCSS.Math.Content.HSA-REI.B.4b: Solve quadratic equations by inspection (e.g., for *x*2=49), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as *a*±*bi* for real numbers *a* and *b*.

For this lesson, it is important that students know and understand the following vocabulary:

* Quadratic equation
* Complex solution

Students need to have previous understanding of the different methods for solving quadratic equations whether it is by taking square roots, completing the square, or using the quadratic formula. They will need to understand that the quadratic formula may give complex solutions that may be written as *a* ± *bi* for real numbers *a* and *b*.

First, there needs to be a short lesson on how to solve quadratic equations using the quadratic formula. A good activity for teachers to do with students is the ‘Oral Practice’ in the book on page 245. This activity can be done as a class so that all students participate and hear the vocabulary or in groups and then as a class. Another activity that will help students very much is doing practice problems on IXL, the interactive website <http://www.ixl.com/math/algebra-1> under BB.9. For formative assessment, the teacher can walk around and peek over at the students screen and see on the top right corner how students are doing. For homework practice problems, I would suggest giving students problems 1-10 on page 245 in the book.



At the end of finishing teaching the cluster, the teacher could give students a short quiz covering everything seen to use it as a benchmark assessment in order to assess their understanding of the standards under the cluster.