High School Algebra I
Solving Quadratic Equations

This learning progression covers Solving Systems of Equations using multiple methods, and is designed for a high school Algebra I class that will mainly consist of 9th graders. The Common Core State Standards that this learning progression will meet are HAS.REI.B.4.A and HAS.REI.B.4.B. The Mathematical practices that this progression will meet are MP1, MP5, and MP8.

The textbook they will be using in this class is Applications, Equations, Graphs, by Larson, Boswell, Kanold, & Stiff, published in 2004. The sections from the textbook that we will be using during this progression that align with the CCSS standards are 9.1 Solving Quadratic Equations by Finding Square Roots, 9.5 Solving Quadratic Equations by the Quadratic Formula, 10.5 Factoring, and 12.4 Completing the Square. They have previously been working on graphing quadratic equations, and for this learning progression they will be solving quadratic equations using different methods. These methods will include completing the square, by inspection, taking square roots, the quadratic formula, and factoring. The central focus of this learning progression will be identifying which method to use to solve the quadratic equation and then actually solving the quadratic equation using the given methods.

We will start the learning progression by first going over notes, definitions, and example problems for each of the methods. I will do a problem for each method, with them following along so they can see the steps, and then give them another similar problem to try on their own before going over it as a class. They will have problems to work on for the remainder of the class period either on their own or with a peer to get more practice with the concepts. By focusing on definitions, notes, and practicing examples on this first lesson while also having time to work with other peers, students will have plenty of time to get a good understanding of these concepts before doing the activities for the following two lessons. Grouping higher-achieving students with

Common Core State Standards

Content Standards

CCSS.MATH.CONTENT.HSA.REI.B.4.A
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.4.B
Solve quadratic equations by inspection (e.g., for $x2 = 49$), 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 $a \pm bi$ for real numbers a and b.

Mathematical Practices

CCSS.MATH.PRACTICE.MP1
Make sense of problems and persevere in solving them.

CCSS.MATH.PRACTICE.MP5
Use appropriate tools strategically.

CCSS.MATH.PRACTICE.MP8
Look for and express regularity in repeated reasoning.

lower-achieving students is beneficial for both students since they get to discuss their ideas and teach each other, so this would be especially beneficial for a student with an IEP or a 504 plan, because they may be struggling with the concepts. By placing them with a student who is proficient with the concepts, it could help them gain a better understanding.

On the following day, we will start out with an entry task, see benchmark assessment 1 and 2. These benchmark assessments will help students to briefly review the material learned yesterday before starting on the activity. After completing the entry task and going over the solutions, I will prompt the students by asking what the necessary steps are for completing the square, to make sure they understand the steps for this method. I will also ask them what the quadratic formula is for review. We will also be discussing how to identify when to use each of the methods to make sure they can see the difference in equations. We will be doing a group activity for the majority of the period, where students are put into groups of 3-4 people and will start at one station where they will have problems to work out as a group involving completing the square, taking square roots, and the quadratic formula. I will be grouping students myself instead of letting them pick their groups to ensure that students of all different achievement levels are mixed into each group so that they can all help each other learn and better understand the concepts. By doing this it keeps any one group from having all students who are very comfortable with the concepts, and then having a group with all students who are struggling and unable to help each other. After a set amount of time, groups will rotate to the next station to complete the next set of problems, and repeat this process until they have made it back to their original station. Once back at their original stations, I will pick one person from each group to come up to the board and write their groups work and solution to one of the problems they solved, along with explaining their work. Students will

Benchmark Assessment 1:

Solve $3(x-2)^2=21$

Benchmark Assessment 2:

Solve $x^2+6x-8=0$ by completing the square.

compare work with others and this will be a way to formatively assess their understanding of these two concepts thus far. I will be walking around the room checking group work to check their understanding, along with having each group write one of their solutions to a problem on the board so that the class as whole can go over the problems and see what was done correctly and what needed to be fixed in the solutions.

The third and final day of this learning progression, students will start off the period with an entry task, with a problem where they have to complete the square, and another problem where they have to use the quadratic formula as a review for the previous day. See benchmark assessments 3 and 4. These assessments will help them to review the methods from the previous day, since we will be focusing on the method of factoring for this activity. For this lesson, we will be playing factoring bingo. I will have a list of possible factored solutions and each student will have a bingo board where they write down the factored solutions on their bingo board in whatever spots they want. I will then go through the list of polynomials randomly one at a time and give students time to work them out on a separate sheet of paper. Once they think they have it they will find it on their board and mark it off with some sort of marker (candy maybe, etc). Once they get 5 in a row, we will check it as a class to see if they correctly factored all of the polynomials. During the bingo game, when a student wins, we as a class will check the answers and steps to make sure there weren't any mistakes. By doing this, all of the students can see common mistakes that are made and how to fix them. If time permits, we can change it up and also do a black out round where they have to try and mark every square on the board. I will collect students work that they have done on a separate sheet of paper to check for their understanding during the activity, and give them an entry task the following day to review factoring, see benchmark assessments 5 and 6.

Benchmark Assessment 3:

Solve $5x^2-10x+30=0$ by completing the square.

Benchmark Assessment 4:

Solve $3x^2+8x=35$.

Benchmark Assessment 5:

Solve $9t^2-12t+4=0$

Benchmark Assessment 6:

Solve $x^2-10=3x-6$