**Unit 8: Systems of Linear Equations and Inequalities**

**(5 Weeks)**

**UNIT PLAN**

***This unit combines Algebra 1 Unit 6 with the first investigation in Algebra 2 Unit 1.***

**Storyline**

In previous units, students studied linear functions and used a linear function to investigate the relationship between two variables. In this unit, students will represent, compare and analyze two linear equations, look for common solutions and use this information to make choices between competing situations in real world contexts. Students will solve systems of equations numerically, graphically, and algebraically. They will be able to explain what the solution of a system of linear equations represents in the context of various applications such as those used by business leaders, economists, scientists, engineers, nutritionists, racecar drivers, and athletes.

They also will explore the special cases of parallel lines (no solution) and identical lines (infinite solutions).

In **Investigation 1 Solving Systems of Linear Equations (Algebra 1 Unit 6 Investigation 1),** students may work in small groups to determine whether or not women’s salaries within a specific salary range will ever equal the men’s salaries. Students will use their knowledge from Unit 5 to calculate the intersection point of two linear functions using the graphing calculator. Once they have the point of intersection, they will explain what the point of intersection means in the context of the problem. The next application will have the students explore under what conditions one gym membership is more economical than another. Students may solve the problem by working in small groups using different approaches such as making a table, solving an equation, graphing by hand, and graphing on the calculator. Then they share their solutions, with the class.

**Investigation 2 Solving Systems of Linear Equations Using Substitution (Algebra 1 Unit 6 Investigation 2)** uses a non-profit organization as a context to explore solving systems of linear equations by substitution. Through questions posed by the teacher, the students will be guided through the process of how to solve a system of equations by substitution. This strategy builds upon students’ skill evaluating expressions given the value of one or more variables. In order to explore the case when two equations are given in slope-intercept form, the students will study car racing where the slower car receives a head start. They also will study another application, the economics of the breakeven point, a situation in which revenue equals cost.

In the **Investigation 3** **Solving Systems of Linear Equations Using Substitution (Algebra 1 Unit 6 Investigation 3)** students work with linear equations that model situations such as a computer assembly line and designing a fund raiser. These scenarios are not easily solved using the substitution method and therefore motivate the need for solving systems of equations using elimination. Students will use and explain the algebraic principles that support the elimination method.

Through the first three investigations in this unit, students will understand how to solve equations involving two unknowns, both algebraically and graphically. Students will identify the point of intersection of the two lines as the solution of the system of equations and then interpret the solution in the context of the problem. Students will recognize when one method of solving a system of linear equations is more advantageous than another.

**Investigation 4 Systems of Linear Inequalities and Linear Programming** is the same as Investigation 1 in Unit 1 of Algebra 2. It extends students’ understanding of algebra and graphing techniques to the solution of a system of linear inequalities. It then extends their understanding to modeling and solving LP optimization problems. Students will graph the solution set of a linear inequality in two variables and solve systems of inequalities graphically by hand, and with a graphing calculator. They will identify the boundary lines, half-planes, feasible region and vertices of a feasible region and determine the objective function for a real-world problem. Students will apply the Fundamental Principle of Linear Programming (the maximum/minimum solution occurs at a vertex of the feasible region when certain conditions are met such as the feasible region is bounded) and determine the optimal solutions to real-world problems.

**Essential Questions**

* What does the number of solutions (none, one or infinite) of a system of linear equations represent?
* What are the advantages and disadvantages of solving a system of linear equations graphically versus algebraically?

**Enduring Understandings**

* A system of linear equations is an algebraic way to compare two equations that model a situation and find the breakeven point or choose the most efficient or economical plan.

**Unit Contents**

Investigation 1: Solving Systems of Linear Equations (3 days)

Investigation 2: Solving Systems of Linear Equations Using Substitution (2 days)

Investigation 3: Solving Systems of Linear Equations Using Elimination (3 days)

Investigation 4: Systems of Linear Inequalities and Linear Programming (4-5 days)

Performance Task: Community Park (3 days)

End of Unit Test (2 days, including review)

**Common Core Standards**

*Mathematical Practices #1 and #3* *describe a classroom environment that encourages thinking mathematically and are critical for quality teaching and learning. Practices in bold are to be emphasized in the unit.*

1. Make sense of problems and persevere in solving them.

2. Reason abstractly and quantitatively.

3. Construct viable arguments and critique the reasoning of others.

**4. Model with mathematics.**

**5. Use appropriate tools strategically.**

6. Attend to precision.

7. Look for and make use of structure.

8. Look for and express regularity in repeated reasoning.

**Standards Overview**

* Create equations that describe numbers or relationships
* Solve systems of equations
* Represent and solve equations and inequalities graphically

**Standards**

A-CED 3. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.

A-REI 5. Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.

A-REI 6. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

A-REI 11. Explain why the *x*-coordinates of the points where the graphs of the equations *y* = *f*(*x*) and *y* = *g*(*x*) intersect are the solutions of the equation *f*(*x*) = *g*(*x*); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where *f*(*x*) and/or *g*(*x*) are linear functions.\*

A.REI 12. Graph the solutions to a linear inequality in two variables as a half plane (excluding the boundary in the case of a strict inequality) and graph the solution set of a system of linear inequalities as the intersection of the corresponding half-planes.

**Vocabulary**

Addition Property of Equality

Breakeven Point

Elimination Method for Solving Systems of Equations

Fixed Cost

Half Plane

Multiplication Property of Equality

Objective Function

Optimization

Profit

Revenue

Shading

Solution of a System of Linear Equations

Solution of a System of Linear Inequalities

Substitution Method for Solving Systems

Substitution Property of Equality

System of Linear Equations

Test Point

Total Cost

Transitive Property of Equality

Variable Cost

**Assessment Strategies**

**Performance Task: Community Park**

Students will complete a plan for a community park that contains a basketball court, walkways, and a feature (like a fountain or gazebo) at the intersection of the walkways.

**Other Evidence (Formative and Summative Assessments)**

* Exit slips
* Class work
* Homework assignments
* Journal entries
* Algebra 1 Unit 6 Test\*

\* To assess Investigation 4, you may add questions 1 and 7 from Algebra 2 Unit 1 test.